Towards a Mobile-Mediated Action Learning Framework for Pre-Service Teachers: A Design-Based Research Perspective

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DECLARATION

I declare that this thesis is my own work and that it has not been submitted before, for any purpose, to any other institution. I authorise the University of Cape Town to reproduce for research either the whole or any portion of the contents in any manner whatsoever.

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ABSTRACT

Although mobile devices are ubiquitous, their adoption as tools for teaching and learning in a 21st-century classroom remains a challenge. Mobile devices over the last decade have created significant shifts in society, changing how we communicate, access information and collaborate. However, in education, the pedagogical uses of mobile devices have been limited. This study argues that exposing pre-service teachers to mobile learning innovative pedagogies and technological enhancements can increase pedagogical uses of mobile devices. Thus, an intervention was designed, implemented and evaluated with pre-service teachers over four years with three different cohorts at the International University of Management (IUM) in Namibia. A design-based research (DBR) approach was utilised to draft design principles.The draft design principles guided the design of a Mobile-Mediated Learning Intervention (M-MLI). Data were collected through a fact-finding study, pre-service teachers, created artefacts, observations, reflections, transcripts posted on a Padlet (a technological application), the formative evaluations of each iteration, as well as the Progress Report Journals (PRJ). As a key outcome of the DBR, a set of refined design principles for mobile-mediated learning experiences emerged. These principles have the potential to guide other educators in designing and facilitating pre-service mobile-mediated learning in authentic education contexts. Gadamer's Hermeneutic Learning Experience (HLE) theory was employed to understand the dialogical approach between the past (part) and the present (whole), pre-service teachers' perceptions of mobile learning (past) and experiences of using a mobile tool (present). Key findings demonstrated that mobile-mediated learning experiences can be achieved through the construction of an authentic learning instructional approach which allows pre-service teachers to discuss, explore and collaborate to construct new knowledge and create new artefacts in real-world settings and tasks environment. The practical contribution of this research lies in the creation of design principles for a M-MLI for pre-service teachers. While the theoretical contribution of this study is the mobile-mediated action learning framework (M-MALF), which operationalizes mobile learning within pre-service teachers' programs in the Namibian context.

ABBREVIATIONS / ACRONYMS

4IR	Fourth Industrial Revolution
AL	Action Learning
CSCL	Computer-Supported Collaborative Learning
DBR	Design-Based Research
DPs	Design Principles
EFA	Education for All
ETs	Educational Technologies
HEIs	Higher Education Institutions
HLE	Hermeneutic Learning Experience
ICTs	Information and Communication Technologies
IT	Information Technology
IUM	The International University of Management
LMS	Learning Management System
M-MALF	Mobile Mediated Action Learning Framework
M-MLI	Mobile-Mediated Learning Intervention
ML	Mobile Learning
MoE	Ministry of Education
NUST	Namibia University of Science and Technology
PRJ	Progress Report Journal
RQ	Research Question
SAMR	Substitution Augmentation Modification Redefinition
SDGs	Sustainable Development Goals
UNAM	University of Namibia

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CHAPTER 1: INTRODUCTION

1.1 Chapter Overview

This chapter provides an overview of why the study was designed, how it was carried out, and the theoretical underpinnings that were applied. Firstly, it introduces the study by discussing the need to explore ways in which emerging technologies (ETs) in education can be used to transform education in Namibia by articulating the potential of mobile learning in teaching and learning to promote the transformation. This situates the study within the context of educational technologies, mobile learning, digital learning, education transformation, teacher education, and the development of the study's key constructs. Somewhat unorthodoxly, I also clarified my positionality in the study by reflecting on how I regarded ETs in my own instructional context. Secondly, the study problem and questions, the objectives and data collection procedures are framed within the theoretical constructs. Thirdly, I present a general overview of the Design-Based Research (DBR) methodology, which was adopted for this study. The chapter concludes by providing the overall structure of the thesis.

1.2 Introduction of the Study

In recent years, the integration of technology in education has gained significant attention worldwide. Mobile devices, such as smartphones and tablets, have become increasingly prevalent and offer new possibilities for teaching and learning. This has led to the emergence of mobile learning, which refers to the use of mobile devices and applications to facilitate learning and educational experiences (Crompton & Burke. 2020). Pre-service teachers, individuals who are studying to become teachers, represent a crucial group in the context of mobile learning. As future educators, they play a vital role in shaping the educational experiences of their future students. Therefore, understanding their perceptions, attitudes, and experiences regarding mobile learning is essential for effectively integrating mobile technologies into teaching practices.

While there is a growing body of research being conducted on the technological aspects of mobile learning, such as the efficacy of certain applications or platforms, there is a need to investigate the pedagogical implications of mobile learning among pre-service teachers (Kearney & Maher, 2019). It is critical to understand how mobile devices can be implemented into pre-service teacher education programs and how they can improve teaching and learning processes.

There is growing evidence supporting the introduction of mobile technologies in education (Ally et al., 2014; Kearney & Maher, 2019; Sánchez-Prieto et al., 2019). Correspondingly, studies on mobile learning in Namibia reveal that there is a need to explore ways of adopting mobile devices into teaching and learning (Osakwe et al., 2015; Osakwe et al., 2017; Osakwe et al., 2019). Kukulska-Hulme and Traxler (2020) emphasise that "*learning with mobiles has gradually become imbued with multiple meanings, some emphasizing the physical mobility of learners; some focusing on the affordances of mobile technology; some emphasizing connections between contexts or settings; and some noting the primacy of access to digital resources"* (p. 182).

Subsequently, due to the increasing physical mobility of mobile devices such as multi-core processors, touch screens, sophistication, storage, fast network connectivity, smartness, high quality cameras, among others, for mobile devices, this has created interest among researchers and scholars to talk about the adoption of mobile technologies in formal education under the name of mobile learning or M-learning (Ally et al., 2014; Sánchez-Prieto et al., 2019). Following the physical features of mobile technologies, Bower (2008, p. 6) proposed a framework for classifying e-learning technology affordances[1] to support the educational and collaborative design of learning tasks. Bower describes e-learning technology affordances by emphasising the action possibilities they offer the user, such as:

- ***Media affordances*** – the type of input and output forms, such as text ("read-ability", "write-ability"), images ("view-ability", "draw-ability"), audio ("listen-ability", "speak-ability"), video ("watch-ability", "video-produce-ability").

- ***Spatial affordances*** – the ability to resize elements within an interface ("resize-ability"), move and place elements within an interface ("move-ability").

- ***Temporal affordances*** – accessible anytime, anywhere (accessibility), ability to be recorded ("record-ability") and played back ("playback-ability"), as well as synchronous versus asynchronous ("synchronicity").

- ***Navigation affordances*** – capacity to browse other sections of a resource and move back/forward ("browse-ability"), capacity to link to other sections within the resource or other resources ("link-ability"), ability to search ("search-ability") and sort and sequence ("data-manipulation-ability").

- ***Emphasis affordances*** – capacity to highlight aspects of a resources ("highlight-ability"), explicitly direct attention to particular components ("focus-ability").

[1] The term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used (Bower, 2008). For instance, how mobile devices could possibly be used in teaching and learning

- ***Synthesis affordances*** – capacity for combined multiple tools together to create a mixed media learning environment ("combine-ability"), the extent to which the functions of tools and the content of resources can be integrated ("integrate-ability").

- ***Access-control affordances*** – capacity to allow or deny who can read/edit/upload/download/broadcast/view/administer ("permission-ability"), capacity to support one-one/ one-many/many-many contributions and collaborations ("share-ability").

- ***Technical affordances*** – capacity to be used on various platforms with minimal/ubiquitous underlying technologies, ability to adapt to bandwidth connection, speed and efficiency of tool/s.

- ***Usability*** – intuitiveness of the tool, ease with which the user can manipulate the tool to execute its various functions and relate to efficiency.

- ***Aesthetics*** – appeal of design, appearance of interface, and relates to user satisfaction and ability to hold attention.

- ***Reliability*** – robustness of platform, system performs as intended whenever required.

As aforementioned, much thinking by researchers is evolving around design for learning with technologies or mobile devices to be specific (Beetham & Sharpe, 2020; Bower, 2008; Cai, 2021; Kukulska-Hulme & Traxler, 2020), as m-learning is said to offer benefits such as "access to information when and where it is needed" (Koole & Ally, 2006, p. 1). It also increases the availability of open educational resources to learners at no or minimal cost (Ally et al., 2014), enhances communication and collaboration (Osakwe et al., 2015), and transforms learning activities to be truly personalised, situated, and connected through mobile devices (Kukulska-Hulme & Traxler, 2020; Romrell et al., 2014).

Attributable to the potential of mobile devices in formal education, there is an ongoing need to examine the suitable pedagogical framework for adopting m-learning in a formal educational setting (Kearney & Maher, 2019; Kearney et al., 2012; Kim et al., 2017). This new approach has several limitations and challenges that still exist, such as the need for teacher (both pre-service and in-service) support and training (Ally et al., 2014; Baran, 2014), the need to optimise mediated learning by mobile technologies (Kearney et al., 2012), m-learning resistance and acceptance among users (Baydas & Yilmaz, 2018; Kim et al., 2017), "insufficient experience, mobile phone bans in schools, and curriculum adaptations" (Baran, 2014, p. 25). These signs point out the critical areas for the adoption of mobile technologies in educational settings.

In an endeavour to address the complexities of mobile technologies in teaching and learning and how they can be more effective as a pedagogical tool, the following questions are asked: Where does one begin in attempting to address the intricacies of mobile devices in teaching and learning? How may mobile devices be used to enhance teaching and learning? How can mobile devices be used to teach? Mobile learning is one of the viable ways of incorporating educational emerging technologies into a twenty-first-century classroom (Cai, 2021; Crompton & Burke, 2020; Kearney & Maher, 2019; Kukulska-Hulme & Traxler, 2020; Ministry of Education, 2022). In view of its educational potential, the development of a pedagogical approach to mobile learning in education is critical.

Literature indicates that various studies have been conducted on m-learning (Benali & Ally, 2020; Cai, 2021; Kearney et al., 2012; Kukulska-Hulme & Traxler, 2020; Ophoff, 2013). However, teacher support and teacher training have been the least explored topics in mobile learning research (Romrell et al., 2014). Additionally, out of 37 studies that were analysed by Baran (2014) on m-learning, only five studies reported using a theoretical or pedagogical framework to design or implement the research. Baran (2014) asserts that the literature lacks new approaches, models, and frameworks for teacher education programmes designed specifically to develop m-learning pedagogies. Moreover, “no systematic research has been conducted on mobile learning and teacher education” (Baran, 2014, p. 1) .

Subsequently, during the Namibian national conference on education under the theme “Transforming Education Towards Inclusion and Quality in the Context of Global Challenges”, one presenter discussed ways for transforming education in Namibia through responsive and inclusive digital learning (Mr Nkusi, the Acting Director, Teaching and Learning Unit, at the Namibia University of Science and Technology (NUST), and recommended that the Namibian education system must find ways to introduce the use of mobile devices in teaching and learning. Furthermore, Namibia has recognized the importance of technology in education through initiatives such as the National ICT Policy for Education (MOE, 2005). Introducing mobile learning for pre-service teachers aligns with the national goals of integrating technology in education and building a digitally empowered society. Mobile devices have become increasingly accessible and affordable in Namibia, providing an opportunity to leverage these devices for educational purposes. Introducing mobile learning ensures that pre-service

teachers have access to technology tools that can enhance their learning experiences and better prepare them for the digital age. By incorporating mobile learning, pre-service teachers can participate in collaborative activities, explore real-world examples, and personalize their learning experiences. The present study, therefore, sought to explore this niche that is evolving around the area of mobile learning and develop a pedagogical framework on how to integrate mobile learning into teacher education specifically in Namibia.

As aforementioned, the proposed framework that can guide teacher training (for this case, pre-service teachers) on how to use mobile devices in teaching and learning, was guided by the four phases of the Design-Based Research (DBR) approach using the Gadamerian Hermeneutics Learning Experiences (HLE) and Action Learning (AL) theory. The study's premise was that when mobile devices are used for teaching during pre-service teacher training, pre-service teachers will have the opportunity to experience and comprehend the pedagogical features of how mobile devices can be effectively employed as a mode of teaching and learning.

My argument for this study is consistent with that of McManus (2007), who contends that when an individual learns through life experience, they undergo a radical shift in consciousness (present views), which may transform their previous beliefs or views (past views) and lead to the development of a new understanding (future views). To embrace mobile learning (m-learning) as a teaching method, it is necessary to investigate how a pre-service teacher might engage in learning that is mediated by a mobile device and is more likely to inform their future pedagogical practices. This will also enable pre-service teachers to have an opportunity to be engaged in mobile learning from a student’s perspective (Warnke, 1987, as cited in Ally et al., 2014) and also be able to have an appreciation of the benefits and potential of learning with mobile devices.

My motivation for this study was that the study has practical relevance because it is based purely on qualitative data gathered from a group of pre-service teachers within the Namibian educational context, which informed the research findings. Furthermore, the concepts of hermeneutics developed by the German philosopher, Hans-George Gadamer (1900 - 2000), were employed to guide the formulation of research questions

and study objectives. These concepts are: *Fusion of Horizons, Prejudice, Dialogue, Reversal in Consciousness,* and *HLE* (see Chapter Six) (Clark, 2008).

The purpose and significance of the study was to:

(a) Develop design principles for implementing intervention where pre-service teachers can experience the mobile-mediated pedagogical practices that may develop their reflective capacity for their future teaching and learning environments (Baran, 2014; Fritschi & Wolf, 2012), and

(b) Enhance understanding of the pedagogy of mobile-mediated learning in the Namibian context. A few studies (Osakwe et al., 2015; Osakwe et al., 2017; Osakwe et al., 2019) on mobile learning in Namibia focused on the investigation of attitudes and in-service teachers' perceptions of mobile learning. Systematic pedagogical design-based research (DBR) on the mobile-mediated learning experiences of pre-service teachers in Namibia was carried out in this study. This might be the first study in Namibia to do design-based research on mobile-mediated action learning and pedagogical strategies for integrating m-learning for teacher education. In addition, this study provides invaluable contributions towards educational planning in Namibia and beyond on how to implement practical and effective approaches to adopt mobile learning in teacher education. Furthermore, the findings of this study may be useful to educators, including pre-service and in-service teachers, within similar contexts of mobile learning. In fact, they may be able to use the design principles for mobile-action learning that emerged from this study as practical guidance for teaching with mobile devices.

(c) Contribute to knowledge of mobile learning among pre-service teachers. By examining their perceptions, attitudes, experiences, and the contextual factors that influence mobile learning, this study will contribute to the existing literature on technology integration in teacher education. The findings will inform teacher education programs, policy-making, and the development of effective strategies and guidelines for integrating mobile devices into pre-service teacher education curricula. Ultimately, this research seeks to enhance the quality of teacher preparation and improve the future educational experiences of students through the effective integration of mobile learning.

1.3 Rationale of the Study

The rationale for the study was driven by my personal interests, practices, and experiences as well as the theoretical analysis of the technological demands of the 21st century classroom and the potential of mobile learning in education. Thus, the next section highlights my positionality in the study as well as the description of the demand for Emerging Technologies (ETs) in the 21st century classroom and an overview of the mobile learning context of this study.

1.3.1 My Positionality in the Study

Having served as a teacher educator for more than seven years and as the Dean of the Faculty of Education at the International University of Management (IUM) Namibia, I have observed that during my lectures (Teaching Methods classes), face-to-face contact sessions, and those of my colleagues (other educators), students often use their mobile phones to search for the meaning of a certain concept, take pictures of lecture notes/PowerPoint presentations, and display videos during their presentation, etc.

In the early days of such observations, I could not appreciate the relevance of students' practices of their mobile phones during lectures, and as a result, I perceived it to be an excuse for them to be on their phones during lectures. This led to my instructing students to switch off their phones during lectures. Little did I know that they were holding a powerful tool that can be used for advanced teaching and learning. The common purpose for using mobile devices among my students was that it serves as: (i) a mode of communication; (ii) a device they use when searching for academic information; and (iii) a device used for social connections and engagement through social media platforms or applications, of which the WhatsApp application is commonly used among the students to share their academic issues and so forth (see Chapter Five analysis of the fact-finding study).

However, as a teacher educator, I never developed a lesson plan to integrate a mobile device as a teaching tool. Instead, during students' peer teaching, I usually advised students to integrate ICTs into their lesson plans (as per the Namibian Basic Education school curriculum requirements). As a result, I have observed that students mainly use PowerPoint presentations as a way of integrating ICTs during their peer teaching. This serves as an indication that students are subsequently exposed to the notion of

Emerging Technologies (ETs) and mobile devices in teaching and learning. However, an essential aspect is missing, which I believe should follow such exposure, and this is the practical use of such ETs and mobile devices to their full potential during their training. Thus, I observed that we technically limit ourselves to only teaching and learning *about* technologies instead of teaching or learning *with* technologies (see Lautenbach, 2014). This shall serve as a contributing factor towards the need for a shift in personal disposition and prejudice associated with mobile devices.

Similarly, after reading journal articles on the potential of Mobile Learning (ML) in teaching and learning as a global and continental trend (Baran, 2014; Baydas & Yilmaz, 2018; Benali & Ally, 2020; Bikanga Ada, 2018; Crompton, 2017; Crompton & Burke, 2020; Kearney & Maher, 2019; Padirayon et al., 2019; Passey & Zozimo, 2016; Schmitz et al., 2015), as well as on Namibians being m-learning ready (see Osakwe et al., 2017; Osakwe et al., 2019), I found it interesting and necessary to research and synthesise the potential of m-learning in pre-service teachers' training programmes from the Namibian context.

To think of the potential of mobile learning in Namibia, evidence from the fact-finding study (see Chapter Five) that was conducted to determine the IUM pre-service teachers' (doing Bachelor of Secondary Education) perceptions of the use of mobile devices in teaching and learning, shows that 96.2% of students have smartphones, while some of them have laptops, tablets, iPads, etc. Students also indicated that they were using mobile devices informally to complete their assignments and projects, as well as access academic information daily. Following my previous lecturing practices, I once tasked my students to do a video recording of their peer-simulated teaching practice with their smartphones, and that was to be submitted to me via electronic mail or on a USB. The students shared their experiences, and they indicated to me that it was an exciting mediated experience and that they preferred doing their presentation without being observed by the lecturers in class, as it allowed them to be confident, innovative, creative, collaborative, and fun. My assumption in connection to this study is that if their recorded videos on their mobile devices were shared on the Padlet wall or other technological learning platforms, the class would have created a mediated mobile learning resource that could be used in teaching.

Nonetheless, from my own analysis, an essential aspect was still lacking, especially in my own class, and this was the construction of a mobile-mediated learning experience for the students to be able to observe and learn how to integrate ETs, especially mobile devices, into teaching and learning (see McManus Holroyd, 2007). My personal notion is aligned with that of Fritschi and Wolf (2012) who argue that if professors (teacher educators) use mobile devices for instruction, pre-service teachers have the opportunity to observe concrete examples of mobile-mediated learning pedagogical strategies and to experience m-learning from a student's perspective. Such practices have not yet been adopted in the Namibian teacher education sector, and especially not in my own class or university as a major focus of the current study.

Therefore, following my personal experiences, practices, and theoretical reviews, and as a teacher educator to be specific, my personal interest in this study was to earnestly seek an understanding of how Mobile-Mediated Learning Interventions (M-MLIs) for pre-service teachers are designed and the principles for developing such interventions. Furthermore, this study aimed to also encourage fellow teacher educators to perpetuate the notion of shifting from teaching *about* ETs to moving towards the notion of teaching *with* ETs (Lautenbach, 2014). This could also bridge the existing gap in the concept in the Namibian literature. Moreover, this study can provide useful design principles for teachers, instructional designers, and educational developers as they plan and develop curriculum resources or learning environments for learners in the 21st century (Herrington et al., 2009). Hence, my research concentrated on developing design principles that can guide the integration of mobile-mediated learning practices in teacher education. That said, the following section presents an overview of the demand for teaching with ETs in the 21st-century classroom.

1.3.2 Demand of Emerging Technologies in the 21st Century Classroom

Having presented my personal motivation for the study, I now want to present the technological demands of the 21st century classroom to further motivate the need for this study. Rapid advances in technology make new solutions available for teachers to help students adapt to the professional needs of a constantly changing world (Sánchez-Prieto et al., 2019). It has been noted that the 21st century classroom may require the integration of pervasive Emerging Technologies (ETs) into pedagogy (see Tarling & Ng'Ambi, 2016). This call requires a multi-pronged approach across all educational levels, whereas teacher education institutions play a critical role in preparing teachers

through both pre-service and in-service teacher training (see Baran, 2014). Teachers, for instance, need to be prepared to effectively engage their students in today's digital learning environments coach them through learning and apply the acquired skills. As a result, the perceptions and preparedness for such educational changes are to develop new teaching skills and pedagogical approaches that are required to enhance learning in the 21st century classroom. To achieve this, one of the approaches could be incorporating ETs into pre-service teachers' training to allow them to learn how to incorporate those technologies into their future class teaching (Baran, 2014; Fritschi & Wolf, 2012).

In October 2019 (UNAM, 2019), I attended a Teacher Education Indaba in Windhoek, Namibia, together with like-minded presenters, in particular Prof. E. Low from Singapore, Prof. J. Jansen from South Africa, Prof. P. Sexton from the USA, and Prof. S. Havu-Nuutinen from Finland. During their presentations, they pointed out the issue of emerging technologies and the construction of 21st century teacher education programmes as a new approach to promoting quality education in Namibia and abroad. The speakers emphasised the possibilities that are available to respond to the technological demands that the 21st century implies for teaching, learning, and assessments. They also argued that for the proper preparation of a well-seasoned 21st century teacher, student teachers as well as teacher educators must be exposed to innovative pedagogies, technological enhancement, and professional practices during their training. Mobile learning was also outlined as one of the potential approaches to improve the quality of education in Namibia. This implies that the issue to be addressed is the challenge of improving the capability of mobile technologies in education, which has been identified to deliver learning faster and more affordably, especially in poor and remote areas like those characterising some parts of Namibia.

It is also worth noting that the challenges that are associated with COVID-19, a global pandemic outbreak that emerged in 2019, may serve as a contributing factor to creating awareness about the potential that mobile devices pose. The measures that were put in place by universities and schools globally in response to the COVID-19 required the exploitation of ubiquitous technologies in teaching and learning. Teaching and learning were facilitated through e-learning platforms available to both teachers and students depending on context. In the Namibian context, students were more likely to use their mobile devices to complete their studies during this period. It is therefore not surprising

that there is a need to explore ways through which mobile devices can be effectively used in teaching and learning. An effective point to effect this change is in pre-service teachers' training.

1.3.3 Mobile Learning (m-learning): An overview

This research study aimed to design a pedagogical framework for mobile mediated learning, which could be significant in providing guidelines for teachers in the 21st century to integrate m-learning into teaching and learning. Mobile learning became recognised as a formal term in education in 2005 (Crompton, 2017). The surging popularity of mobile devices as technologies that support teaching and learning has been widely debated in recent years (Crompton & Burke, 2020; Issham, 2011; Herrington et al., 2009; Kearney et al., 2012; Padirayon et al., 2019). A mobile device can be used as a teaching and learning tool in various educational contexts (Kearney et al., 2012). Even though mobile devices are one of the significant features of mobile learning (Rikala, 2015a), for this study, mobile learning is contextualised as not merely learning through the use of mobile devices but also learning across different contexts and through student engagement, collaboration, reflection, content interaction, and knowledge construction that are mediated via mobile devices. Hence, mobile devices are particularly viewed as a teaching and learning tool for this research. Overall, mobile learning is viewed as a teaching approach and practice that guides the design of an Action Learning Framework.

The reader should also bear in mind that the current study focused on mobile learning that occurs inside and outside of the classroom setting. This means that the research was situated in a formal planned educational context (Rikala, 2015a) with a selected group of six to eight pre-service teachers doing third and or fourth year Bachelor of Secondary Education from the International University of Management (IUM), Namibia. The next section presents an overview of the Design-Based Research (DBR) approach, which is the chosen research methodology for this study.

1.4 Overview of the Design-Based Research (DBR) Methodology

Given the methodological diversity of educational research on mobile learning in teacher education, the present study was set within the overall framework of the design-based research approach. Design-based research (DBR) is defined as *"a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among*

researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (Wang & Hannafin, 2005, p. 6). To a great extent, this study concurs with the conceptualisation of DBR as presented by Anderson and Shattuck (2012), which characterises DBR as situated in real educational contexts, and focuses on the design and testing of interventions using mixed methods involving multiple iterations, a collaborative partnership between researchers and practitioners, and the development of practical design principles. Furthermore, in design-based research, the interventions are developed in a cyclical process (Rikala, 2015a). Consequently, it gives researchers and practitioners the opportunity to produce tools, approaches, frameworks, theories, and products/artefacts that have been tested in the field and are effective (McKenney & Reeves, 2012). Thus, the DBR, as part of its Phase one, requires the researcher to work in collaboration with practitioners and experts in the field by addressing their pre-judgments and perceptions of the research problem to avoid bias.

As per the aforementioned, this study adopted DBR for three reasons: (i) the study was conducted in a real-world pre-service teacher educational context of mobile learning, employing authentic learning design elements (see, Miller, 2012), which guided the design solution of the research problem (see Chapter Seven), (ii) the study aimed to develop refined design principles for designing a M-MLI for pre-service teachers and (ii) to guide the design and development of design principles to advance mobile learning theory in the teacher education context. Chapter Two clarifies how the four phases of the DBR approach were applied in this study.

Following the DBR concepts, this study used both quantitative and qualitative data (Rikala, 2015a). Multiple methods were used to collect data, thereby supporting the triangulation of the data collection method. First, quantitative data were gathered through a survey of all pre-service teachers at IUM doing the Bachelor of Secondary Education degree, as well as interviews with educators and IT practitioners. As a result, in collaboration with participants and practitioners, a fact-finding study (see Chapter Five) guided the identification of the research problem. The fact-finding study was supported by the literature review (see Chapters Three and Four) to facilitate the identification of the conceptual underpinnings of the research problem, which assisted me to understand and envisage the elements of the design solution for the study. These corresponded to the DBR Phase One.

Secondly, the study utilised different case studies, journal articles, and online resources (created my online library through endnotes for the study) that assisted the author to understand and describe the evolution of emerging technologies (ETs) in pedagogy as well as the theoretical basis of authentic mobile learning interventions (see Chapter Three). Subsequently, a theoretical framework for the study was derived from Gadamers' work on HLE and AL to inform the creation of research questions and practical design guidelines (see Chapter Six). Furthermore, based on the fact-finding study, the literature review, theoretical framework, review of mobile learning theory and practices, and pedagogical framework (see the elements of authentic learning proposed by Herrington et al., 2010; Miller, 2012), a design solution was drafted, which informed the development of an intervention to address the identified problem for this study (see Chapter Seven), which was tested through iterative cycles. These corresponded to DBR Phase Two.

Thirdly, following the design and development of the guiding elements of the M-MLI from DBR Phase Two, implementation of the intervention was done using three iterative cycles. This is in keeping with the suggestions by Herrington et al. (2007) that in the DBR context, a single implementation is rarely sufficient to gather enough evidence about the success of the intervention and its effects on the research problem. As a result, qualitative data for this study were gathered during three iterative cycles of mobile mediated learning interventions using a Padlet Wall (a technological tool/application used for this study). Data were collected during a mobile mediated learning intervention using post and pre-evaluation questionnaires (before and after each session per cycle), observations (student engagement/collaboration), chat transcripts, students' artefacts such as discussion forums, authentic task products, and students' PRJ (see Chapters Eight, Nine, and Ten). The analysis of the data was done using the hermeneutic cycle-driven analysis. These paralleled DBR Phase Three.

The research questions were derived from the literature review, the theory of HLE as well as the AL theory (see Chapter Six). These questions were relevant to guide the researcher to find possible learning solutions through interventions that enable the construction of the design principles that guided the development of a Mobile-Mediated Action Learning Framework (M-MALF) as an outcome for this study. The research questions are stated below.

1.5 Research Questions and Theoretical Construct

Primary Question: In what ways does mobile-mediated action learning shift pre-service teachers' dispositions to adopt mobile learning pedagogies into their practice?

Sub-questions:

RQ1: How do pre-service teachers' past views on mobile devices impact the adoption of mobile-mediated action approach?

RQ2: What type of reflection on-action and in-action do pre-service teachers do when engaged in mobile-mediated action learning?

RQ3: How does pre-service teachers' dialogue with peers in a mobile-mediated action learning environment, change dispositions?

RQ4: What conditions enable or constraint mobile-mediated action learning among the pre-service teachers?

Table 1.1 below provides a summary of research questions, theories, and research design that informed this study.

Table 1.1

Summary of the Research Questions, Aims, Theoretical Constructs and Data Collection Procedures for the study

Research Questions+' (RQ) Focus	Aims and Theoretical Construct of the RQs	Data Collection Procedures
RQ1: How do pre-service teachers' past views on mobile devices impact the adoption of mobile-mediated action learning?	***Aims:*** To identify the prejudgment/assumptions of mobile devices in teaching and learning among the pre-service teachers and to identify how the shift/transformation in disposition was achieved to adopt mobile-mediated action learning. ***Theory:*** Prejudice and Biases (identify part = past experiences or pre-conceived judgement on mobile devices), Shift in Disposition (whole = present experiences or judgment, the reversal of consciousness) DBR (identification and analysis of the research problem, construction of design elements)	***Procedures:*** Initial fact-finding/problem identification study to analyse practical problems, a pilot study to identify the prejudgment and past experiences of mobile learning among pre-service teachers; and to formulating and testing the mobile mediated learning design principles that enable the transformation of dispositions among pre-service teachers. ***Instrument:*** Questionnaires developed via online Google forms (for pre-service teachers); conducted an unstructured informal interview via zoom (with educators/ practitioners). This was recorded and transcribed. ***Participants:*** Third-year and final-year pre-service teachers (students) doing Bachelor of Secondary Education, Lecturers/teacher educators, and IT practitioners at IUM

RQ2: What type of reflection on-action and in-action do pre-service teachers do when engaged in mobile-mediated action learning?	***Aims:*** To develop the design principles for developing robust mobile-mediated action learning interventions that enable pre-service teachers to reflect both during and after the M-MLI ***Theory:*** Action learning (reflection on-action and reflection in-action, enable mobile experiential learning) DBR (interventions, three iteration cycles of testing possible solutions in practice)	***Procedures:*** Test and reflect on the formulated design principles from the literature and fact-finding studies through iterations; created a technological intervention: e.g., Padlet wall to support reflective learning and develop mobile mediated action learning experiences ***Instruments:*** Padlet wall, zoom live sessions, artefacts, observations, interviews ***Participants:*** Four to eight third-year pre-service teachers doing Bachelor of Secondary Education (IUM students) from each field of specialised studies
RQ3: How does pre-service teachers' dialogue with peers, in a mobile-mediated action learning environment, change dispositions?	***Aims:*** To understand how questioning and group discussions addressed the prejudice and biases among pre-service teachers during mobile-mediated action learning. To understand how the change in disposition was achieved through dialogue ***Theory:*** Dialogue - (reflection on-action and in-action), prejudice and bias - (experiential action mobile learning; wrapped in reflections); DBR (testing of the designed elements and solutions)	***Procedures*:** Scaffolding, coaching by the researcher, focus group discussion with participants, and questioning during experiential M-MLIs ***Instruments:*** Discussion and authentic tasks completed on a Padlet wall ***Participants:*** Four to eight third year pre-service teachers doing the Bachelor of Secondary Education (IUM students) from each field of specialised studies.
RQ4: What conditions enable or constraint the mobile-mediated action learning among the pre-service teachers	***Aims:*** To understand and reflect on how the pre-service teachers' past experiences encountered with the present experiences through mobile-mediated action learning. To identify the constraints of mobile mediated action learning that are experienced by the pre-service teachers during the intervention ***Theory:*** Fusion of Horizons - (dissonance as past mobile experience meets present experience); Authentic Learning, Constructivist Learning and DBR (refinement and enhancement of designed solutions)	***Procedures:*** Encourage questioning on reflection before, during and after mobile-mediated action learning intervention using a Padlet wall as well as pre and post evaluation questionnaires ***Instruments:*** Progress Report Journal (PRJ) for each session, Pre and Post evaluation questionnaires completed before and after the intervention, group discussion via Zoom ***Participants:*** Four to eight third year pre-service teachers doing Bachelor of Secondary Education (IUM students) from each field of specialised studies

To this end, the design of the Mobile-Mediated Action Learning Framework (M-MALF) was developed, evaluated and finalised (see Chapters Eleven and Twelve). These represent DBR Phase Four. The next section outlines the structure of this study as guided by DBR procedural process.

1.6 Structure of the Thesis

This section presents how the thesis is structured as guided by the Design-Based Research (DBR) procedural process as reflected in Table 1.2. Design-based research is a research approach that combines theory, design, and practice to address complex problems in educational settings. It involves iterative cycles of design, implementation, and evaluation, with a focus on developing and refining interventions or innovations that are practical and effective for improving teaching and learning outcomes. Here are the steps that I followed to effectively use design-based research phases for this study and how the structure of thesis chapters was informed by DBR.

DBR Phase 1 Analysis of practical Problems (researcher and practitioners in collaboration) (chapter 3, 4 and 5): Identify a specific problem or challenge in the educational context. This problem should be grounded in theory and supported by empirical evidence. Here, the following steps was followed: (a) Initial round of literature review to identify existing work and learning framework pertaining to the problem identified to help with the creation of the learning solution (chapter 3 and 4). (b) Consultations with education educators, IT educators and pre-service teachers to identify and explore the learning problem was administered (chapter 5). (c) Creation of the research questions to guide the study.

DBR Phase 2 development of solutions informed by existing design principles and technological innovations (chapter 6 and 7): Develop a set of global design guidelines that can guide the development of interventions or innovations. These design guidelines should be informed by relevant theories, literature, and best practices. Based on these guidelines, design and develop the interventions or innovations that you want to implement and evaluate. Here, the following steps was followed: (a) a second round of targeted and in-depth literature review related to existing work and frameworks identified in phase 1 to formulate a set of draft design principles was done (chapter 6). (b) design and development of the learning solution informed by the draft design elements (chapter 7) were formulated.

DBR Phase 3 Testing and refinement of solution (chapter 8,9 and 10): Implement the interventions or innovations in a real educational setting. This involves collaborating with pre-service teachers to ensure that the interventions are feasible, practical, and aligned with the context. Here, data was collected on the implementation process and

gather feedback from participants to refine and improve the design. Use a mix of qualitative and quantitative data collection methods, such as observations, interviews, artifacts, questionnaires, and journals, to gather comprehensive and rich data. Analyze the collected data to gain insights into the strengths, weaknesses, and impact of the mobile-mediated learning experiences among the pre-service teachers. Reflect on the findings and identify areas for improvement or modifications to the design principles and interventions (chapter 8,9 and 10).

DBR Phase 4 Reflection to produce refined design principles and enhance solution implementation (chapter 11 and 12): Based on the analysis and reflection, revise and refine design principles. This may involve adjusting to the design, implementation strategies, or instructional approaches to address the identified issues or enhance their effectiveness and finalize. Share the findings, lessons learned, and refined the design principles that can be adapted to other educational contexts. Here, design principles were refined and research questions were addressed.

Table 1.2

Structure of the Thesis

Chapters	Description of Chapters
Chapter One: Introduction	This chapter provides an overview of how the study was designed, how it was carried out, and the theoretical underpinnings that were applied.
Chapter Two: Research Methodology (a Design Based Research Perspective)	This chapter presents the process of designing this research study and justification for engaging with the DBR, which represents the research methodology aspect of this study.
Phase One of DBR	
Chapter Three: Revolution of Emerging Technologies in Pedagogy and Mobile Learning	This chapter presents a review of literature on the revolution of emerging technologies (ETs) and mobile learning (ML), and the main concepts of this study.
Chapter Four: Review of Literature (Namibian Context)	This chapter provides a literature review from the Namibian context in which this study population and research were based and conducted.
Chapter 5: Analysis of a Fact-Finding Study and Exploration of the Problem	This chapter provides a summary and analysis of a fact-finding (explorative) study and exploration of the research problem in collaboration with practitioners and participants.
Phase Two of DBR	
Chapter Six: Theoretical and Conceptual Framework (Hermeneutics Learning Experience Theory and Action Learning Theory)	This chapter encompasses the preparation of the theoretical and conceptual framework that is adopted and informed the design solution of this study.

Chapter Seven: The Construction of Design Guidelines of the Mobile-Mediated Learning Intervention (M-MLI)	This chapter presents how the author identified, drafted and developed the learning solution as informed by the existing design guidelines of M-MLIs from the literature.
Phase Three of DBR	
Chapter Eight: Implementation of the Iterative Cycle of Mobile-Mediated Learning Intervention (M-MLI) (Cycle One)	This chapter draws on the findings of the first iteration of the M-MLI cycle, which follows the implementation of the drafted design guidelines generated from literature.
Chapter Nine: Implementation of the Iterative cycle of Mobile-Mediated Learning Intervention (M-MLI) (Cycle Two)	This chapter draws on the findings of the second iteration of the M-MLI cycle, which follows the implementation of the drafted design principles generated from the first iterative cycle of M-MLI.
Chapter Ten: Implementation of The Iterative cycle of Mobile-Mediated Learning Intervention (M-MLI) (Cycle3)	This chapter draws on the findings of the third iteration of the M-MLI cycle, which follows the implementation of the revised design principles generated from the second iterative cycle of M-MLI.
Phase Four of DBR	
Chapter Eleven: Reflection to produce refined Design Principles (DPs) for Mobile-Mediated Action Learning	This chapter represents Phase Four of DBR, illuminating the process of formulation, implementation, evaluation, and refinement of the design principles related to mobile-mediated action learning, in which the intervention for this study operated.
Chapter Twelve: Thesis Contribution and Conclusion	This chapter concludes the study by providing a brief review of the entire research process, the research questions and how they were aligned to the design principles of mobile-mediated learning experiences and theoretical aspects. It also explains the contribution of this study and discusses the validity and reliability of the study. And finally, I provide recommendations for proposed future research.

1.7 Definition of Terms

Action Learning (AL): Action learning is defined in this study as learning-by-doing with reflective learning and collaborative learning to find actionable learning solutions that can be applied in the real world. i.e., as pre-service teachers work on a real-life problem while supporting each other through posts and commenting on each other's posts on the Padlet Application.

Authentic learning: This is defined in this study as the learning methods that require students to complete a single realistic and complex task encompassing the entire

curriculum, with all assessable components contributing to that one endeavour (Herrington et al., 2014, p. 25).

Constructivism: Constructivism is explained by Adom et al. (2016) as an approach that allows people to construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences.

Design Guidelines: These refer to the guidelines that allow the researcher to judge how to adopt principles such as mobile-mediated learnability, practicability and consistency so that they can create compelling designs and meet and of exceed the user's needs.

Design Principles (DPs): Design principles are the principles that guided the development of a learning solution that was mediated via mobile devices as underpinned by authentic learning elements.

Design-Based Research (DBR): Design-based research is defined by McKenney and Reeves (2012) as a genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields the theoretical understanding that can inform the work of others (p. 7).

Emerging Technologies (ETs): This is conceptualised in this study as "tools, concepts, innovations, and advancements," intentionally defining "technologies" broadly to include not just tools and software but also concepts such as pedagogies" (Veletsianos, 2016, p. 4).

Hermeneutics: Hermeneutic is the method of interpreting the meaning of a text. It can be applied to the text that is difficult to understand and requires effort to interpret it, based on the changes in the world. In this study, 'text' not only refers to the written transcript, but also to audio-recorded words, written comments about the interview situation, and observations made by the researcher (Fleming et al., 2003, p. 118).

Mobile Learning (ML): Mobile learning is defined in this study as a teaching and learning method mediated through a portable computer, tablet, iPad, and or smartphone. It is any kind of learning method which uses mobile devices.

Personal Learning Environment: Personal Learning Environments (PLEs) are defined as systems that help learners take control of and manage their own learning. This includes providing support for learners to: set their own learning goals; manage their learning both content and process; communicate with others in the process of learning, and thereby achieve learning goals. A PLE may be composed of one or more subsystems such as that it may be a desktop application or composed of one or more web-based services (Martindale & Dowdy, 2016, p. 120).

Pre-Service Teachers: For purposes of this study, the term pre-service teachers is used to describe students or participants who are in their third or final years of study doing the Bachelor of Education Secondary Honours degree.

1.8 Chapter Summary

This chapter introduced the key highlights of my study, which contributed towards the development of a mobile-mediated action learning framework for pre-service teachers. The chapter discussed the rationale of the study, the author's personal motivation for engaging in the study, and an overview of mobile learning and emerging technologies in education. The chapter also highlighted the methodological and theoretical aspects adopted in the study, namely, design-based research (DBR), hermeneutics, and action learning. Lastly, it outlined the structure of the thesis and the definitions of terms. The next chapter (two) introduces the DBR research methodology and how it was used in this study.

CHAPTER 2: RESEARCH METHODOLOGY

2.1 Chapter Overview

Following the design-based research (DBR) approach introduced in Chapter One (Section 1.4), in the current chapter (Chapter Two), the process of designing this research study and the justification for engaging with the DBR which represents the research methodology aspect of this study are presented. It further discusses the four phases of DBR, including the process of each phase, the participants, data collection procedures, and a description of data analysis. The chapter concludes by outlining the ethical considerations of this study.

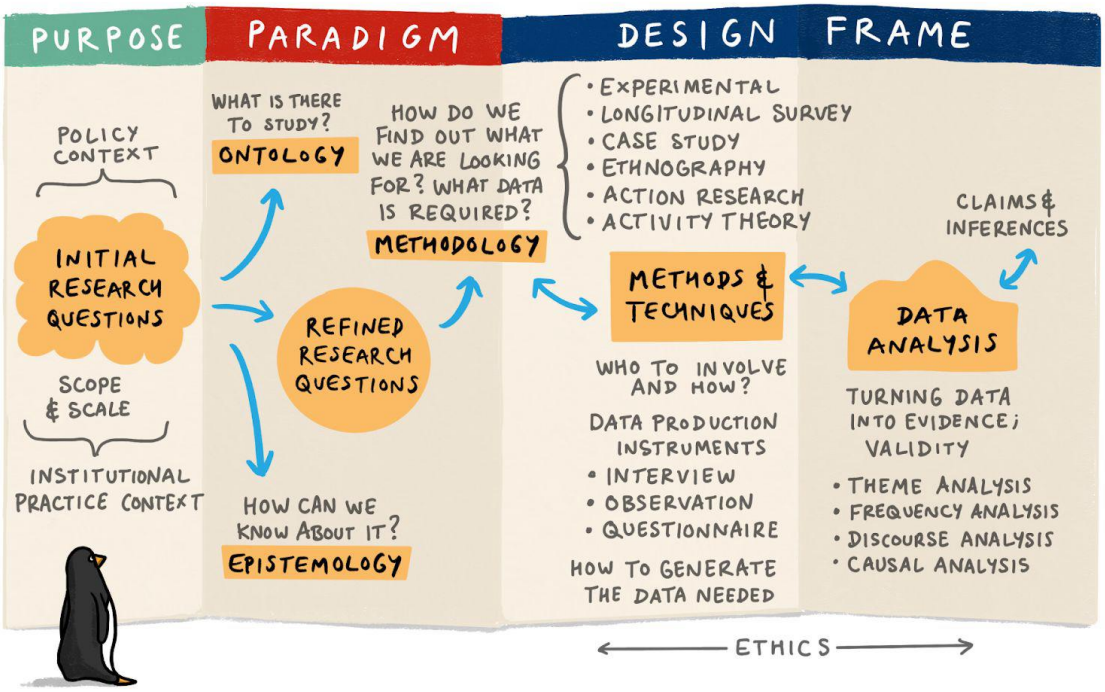
2.2 Process of Designing this Research Study

In this section, I am going to describe the processes of the research design for this study using the research design process diagram (see figure 2.1) extracted from Farrow et al. (2020, p. 118). This diagram shows one way to schematise the research design process by moving from a research question to selecting a research paradigm and generating a process for conducting a research project (Farrow et al., 2020). Following this process, *firstly,* this study began with the review of policies and practices (the context of the research), and identifying the gap and the research problem in the mobile learning and emerging technology field. This informed the potential scope and scale of the study, and initial research questions were developed (see Chapter One).

Secondly, I identify the paradigmatic research approach of the study by answering questions such as: What is there to study? (ontology) and how can I know about it? (epistemology) and how do I find out what I am looking for? What data must I collect? (methodology). During this process, I consulted relevant literature reviews, journal articles, and contributions by other researchers and practitioners in the emerging technology and educational fields (see Chapters Three and Four). The methodological approach was then related to the ontological and epistemological positions (Passey, 2020) that were developed for this study. To this end, a research method suitable for this study was identified, which is the Design-Based Research (DBR) methodology (as described in the preceding sections of this chapter).

Figure 2.1

The Research Design Process



Note: This diagram shows one way to schematise the research design process by moving from a research question to selecting a research paradigm and generating a process for conducting a research project. From "*the GO-GN Research Methods Handbook (p.26)*," by R. Farrow, F. Iniesto, M. Weller, and R. Pitt, 2020. Copyright 2020 by Farrow et al.

DBR provides a key methodological approach for identifying and addressing practical problems, notably in the educational environment, where educational research has long been criticised for being separated from the reality of everyday life (The Design-Based Research, 2003). DBR assumes a timeframe that allows for the collection of data in multiple ways and iteration. Following the DBR approach, data collection procedures and techniques were identified for each phase. To this end, the following sections describe how DBR was employed for this study.

2.3 An Introduction to Design-Based Research

This study is set within the overall framework of design-based research (DBR) which was selected as a suitable approach to address the goal of this study. DBR is a systematic but flexible methodology that is widely used in educational contexts (Bikanga Ada, 2018; Crompton, 2017; Fahd et al., 2021; Koivisto et al., 2018; Stemberger & Cencic, 2014; Wang & Hannafin, 2005). The use of design-based research, also known as *development research*, *design experiments* or *design experimentation* (Herrington et

al., 2010), *educational design research* (McKenney & Reeves, 2012; Reeves et al., 2011), and *formative research/experiments* (Newman, 1990) in educational contexts has increased over the past decade, mostly with educational technology innovations and interventions (Anderson & Shattuck, 2012; Bikanga Ada, 2018) to provide guidelines for enhancing e-teaching and e-learning (Herrington & Oliver, 2000). Design-based research is not so much an approach but a cycle of approaches with the intention of producing new theories, artefacts, and practices that account for and potentially impact teaching and learning in naturalistic settings (Barab & Squire, 2004). The purpose of DBR is to design and develop interventions to solve complex challenges such as programmes, teaching and learning frameworks, materials, and systems (Rikala, 2015a). Hence, the DBR approach uses iterative cycles of analysis, design, evaluation, and revision (Rikala, 2015b). Design-based research is defined by McKenney and Reeves (2012) as:

> a genre of research in which the iterative development of solutions to practical and complex educational problems also provides the context for empirical investigation, which yields theoretical understandings that can inform the work of others (p. 7)

Design based research was founded by A. Brown in 1992, who demonstrated the phenomenon and significance of DBR, that there is a need to:

- determine how various learning environments impact learning and teaching;
- build a more systematic methodology for implementing the design experiment which would involve collaboration between teachers and other researchers and help to form a theory to identify the various factors that influence the success/failure of the introduced innovation; and
- upgrade laboratory research into lessons, with more complex interventions carried out in the demanding and constantly changing environment of the classroom, i.e., to bridge the gap between educational research and the problems present in educational practice (Stemberger & Cencic, 2014, p. 64).

To manage the process in a real-world setting, researchers are actively involved and maintain constant collaboration with participants (for this study, *pre-service teachers and students*), other researchers (for this study, *educators and lecturers*), and practitioners (for this study*, IT Practitioners*), as depicted by DBR (Joseph, 2004), to create new theories, artefacts, and products that have been field-tested and proven to be effective (Reeves et al., 2011). By approaching the research from a design-based

research perspective, this study designed principles for implementing mobile-mediated action learning interventions among pre-service teachers. In the following section, I articulate how DBR is positioned in the traditional research methodological landscape and characterise its context.

2.4 Situating and Characterising Design-Based Research Methodology

According to Cecez-Kecmanovic and Kennan, (2018) "methodology denotes an overall logic of inquiry involving philosophical assumptions behind an inquiry, the strategy of conducting research such as research design and selection and adoption of research methods and techniques, as well as arguments for knowledge construction and justification" (p. 116). Furthermore, research methodology "defines the framework which either defines the boundary within which the research is conducted or upon which the research is founded" (Fahd et al., 2021, p. 4031). Denzin and Lincoln (1998) suggest four basic issues that structure the design of a research study: (a) Which paradigm or meta-theory will inform the study design? (b) Who and what will be studied? (c) Which research strategies/approaches will be used? (d) Which research methods or techniques will be used to collect and analyse data? Hence, an understanding of research methodology focuses on the philosophical assumptions or meta-theories to support and inform the overall strategy, research design, and selection of research methods (Cecez-Kecmanovic & Kennan, 2018). In contrast, research methods and techniques are informed by three elements of the philosophical foundation of research methods: *ontological*[2], *epistemological*[3], and *axiological*[4] to enable the researcher to adopt a critical and reflective attitude towards method selection and application (Cecez-Kecmanovic & Kennan, 2018).

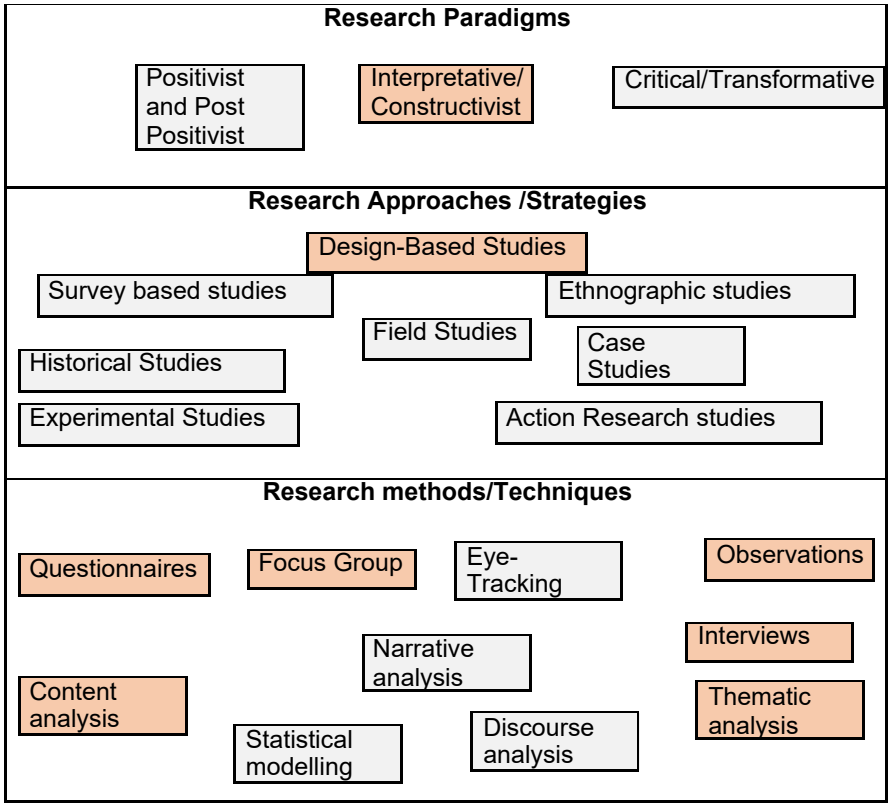
Kali and Hoadley (2021) calibrated DBR's contribution to both the epistemology and ontology of computer-supported collaborative learning (CSCL) research and placed it in traditional research methodology meta-theories. According to them, the types of knowledge produced in DBR fall into different kinds of categories which are determined in part by the ontological commitments we hold as designers and researchers. In doing so, DBR is sometimes used within a positivist paradigm framing to make strong and generalisable truth claims about a presumably objectively knowable world (Kali &

[2] The term ontology refers the "notion of multiple realities being accepted" (it specifies the form and nature of reality and what can be known about it) (Yilmaz, 2013, p. 315); "is the study of being" (Farrow et al., 2020, p. 9).
[3] Epistemology refers to the "idea that understandings are created through interaction between the knower and the unknown or subject" (Yilmaz, 2013, p.315); "is the study of knowledge and methods to generate knowledge" (Farrow et al., 2020, p. 10).
[4] Axiology refers to the "idea that no research endeavor is value-free in that researchers bring their values to what is researched" (Yilmaz, 2013, p. 315); "is the study of values and value judgment" (Farrow et al., 2020, p. 11).

Hoadley, 2021). It is also sometimes employed within an interpretivist paradigm (the selected research paradigm for this study) to examine aspects of human experience that are thought to be knowable only through individual interpretation and are hence fundamentally ungeneralisable (Kali & Hoadley, 2021). Figure 2.2 denotes how DBR was positioned in this study within the framework of the traditional research methodology landscape. To that aim, interpretivist epistemologies might be described as hermeneutics (Schwandt, 2000) learning experiences.

Figure 2.2

The information systems methodological landscape



Note: the figure shows how DBR was positioned in this study within the framework of the traditional research methodology landscape. From *the methodological landscape: Information systems and knowledge management* (2nd ed., pp. 127-155), by D. Cecez-Kecmanovic and M.A. Kennan, 2018. Copyright 2018 by *Elsevier Ltd.* https://doi.org/10.1016/B978-0-08-102220-7.00005-4

The top layer (Figure 2.2) of the research technique landscape depicts the meta-theoretical assumptions that categorise and define the various research paradigms. The philosophical paradigm (highlighted in orange) for this study is framed around the constructivism paradigm (whose mother is the interpretivist paradigm of philosophy),

which helps us to grasp the intricacies and diversity of phenomena in 21st century educational research (Adom et al., 2016). According to the constructivist theory, learning can occur not only in a classroom but also when the learner acquires knowledge through the essence of exploration and doing (Adom et al., 2016). The brain underlying the constructivist paradigm is best illustrated by Confucius' famous quote: "I hear and forget, I see and remember, I do and understand" (Adom et al., 2016, p. 2). What does this statement mean in terms of the present study? It means that if pre-service teachers are exposed to the notions of mobile learning or incorporate mobile devices as a teaching and learning tool in class, they may forget what they learnt afterwards. However, if they see and experience how to integrate mobile devices into teaching and learning, they may retain it even in their future teaching through the sensory activity of seeing.

The most fundamental tenet of hermeneutics is that all human understanding is gained through iterating between considering the interconnected meaning of parts (past-experience) and the whole (current experience) (Smith & Shinebourne, 2012). As a result, this study accepted the constructivist paradigm, which evolved around the Gadamerian theory of HLE (see Chapter Six), thereby allowing participants to interpret their experiences of mobile-mediated learning and how they make sense of their social world through iteration. As a research paradigm, interpretivism is frequently supported with constructivism as an ontological and epistemological foundation, and qualitative methodologies are favoured as a means of investigating these phenomena (Farrow et al., 2020).

The second layer depicts how DBR (the strategy adopted for this study) fits into the standard research methodological landscape and approaches. DBR denotes an integration of the quantitative and qualitative paradigms of educational research (Stemberger & Cencic, 2014). While both qualitative and quantitative methodologies can be employed, it is important to note that DBR does not place a premium on isolated variables (Herrington et al., 2010). As a result, DBR enabled me to generate meanings from the phenomena based on my own experiences, the experiences of the practitioners, and the experiences of the participants.

Finally, the techniques and tools of data collection and analysis are presented at the bottom layer of the landscape, suggesting that a method can be applied by choosing

one or more of the available techniques. For instance, I adopted a combination of questionnaires, interviews, observations, progress reports, journals, content/thematic analysis and narrative analysis for this study. As such, figure 2.3 depicts the process of formulating research aims and questions, followed by the selection of the methodology and techniques to aid in understanding the research methodological process of this study. While table 2.1 summaries the meta-theoretical assumptions of this study.

Figure 2.3

The process of formulating research aims and questions to the selection of methods and techniques for this study

Note: this figure depicts the process of formulating research aims and questions, followed by the selection of the methodology and techniques to aid in understanding the research methodological process of this study. From *the methodological landscape: Information systems and knowledge management* (2nd ed., pp. 127-155), by D. Cecez-Kecmanovic and M.A. Kennan, 2018. Copyright 2018 by *Elsevier Ltd.* https://doi.org/10.1016/B978-0-08-102220-7.00005-4

Given that a researcher is intimately involved in the conceptualisation, design, development, and implementation of DBR as well as the entire research process, the question that arises is, how do you ensure the validity, reliability, and objectivity of DBR? (Anderson & Shattuck, 2012). To respond to this question, advocates of DBR agree that there is no simple solution. They claim that the validity of DBR is ensured through collaboration with participants (for this study, *pre-service teachers, educators*, and *IT practitioners*) and by multiple iterative cycles of testing and refinement of solutions (for this study, *three cycles of mobile mediated learning intervention*), which results in a balancing of theory (*abstract world*) and practice (*physical world*) (Anderson & Shattuck, 2012).

Table 2.1

Meta-theoretical assumption behind this study's research paradigm

Paradigms	**Interpretive/Constructivist** (adopted from Cecez-Kecmanovic & Kennan, 2018)	**Meta-theoretical assumptions in this study**
Reason for research	To describe and understand phenomena in the social world and their meanings in context.	This research aimed to develop design principles where pre-service teachers experience the mobile-mediated pedagogical practices that may develop their reflective capacity for their future teaching and learning environments
Ontology – the nature and existence of social reality	Assumes reality is socially constructed, fluid and fragile, and exists as people experience it and assign meaning to it.	This study is situated in an authentic formal educational learning context. A constructivist paradigm was adopted, which evolved around the Gadamerian theory of HLE (see Chapter Six), allowing pre-service teachers to interpret their experiences of mobile-mediated learning and how they make sense of their social world through multiple iterations.
Epistemology – the nature of knowledge and the ways of knowing	Takes a practical approach to knowledge; aims to include as much evidence about the subject, the research process	A mobile-mediated action learning intervention was conducted as a practical approach of the study.

	and context as possible to enable an understanding of others' lifeworld and experiences and how the researchers came to understand them.	The concept of understanding was informed by the theory of hermeneutics which contextualised that all human understanding is gained through iterating between considering the interconnected meaning of parts (past-experience) and the whole (current experience)
The logic of scientific explanation	The dominant logic of inquiry is inductive and develops idiographic descriptions and explanations based on studies of people and their actions in context; explanations need to make sense to those being studied as well as to the researchers and their community.	The logic of inquiry is inductive and it is based on the interpretation of multiple iterations of mobile-mediated authentic learning contexts among pre-service teachers.
Ethics and claims about values and normative reasoning concerned with what 'ought' to be	Questions the possibility of value-neutral science and value-free research; values are embedded in all human actions (including researchers) and hence are inevitably a part of everything we study, without the judging of one set of values as better than another.	All participants' contributions and participation were valued equally and contributed to the findings of the study.

While reliability and objectivity can be ensured by triangulating sources and data collection techniques (for this study, *questionnaires, interviews, observations, artefacts, posts, progress report journals, and discussion forums*), iterating analyses (cyclically), and using standardised data collection instruments (for this study, a *Padlet wall*) (Stemberger & Cencic, 2014). On the other hand, theory informing practice is at the heart of the DRB approach, and the creation of design principles and guidelines enables research outcomes to be transformed into educational practice (Herrington et al., 2010).

Rikala (2015a, p. 31) combines and summarises characteristics of design-based research from researchers such as Wang and Hannafin (2005), Juuti and Lavonen

(2006), and Andersson and Shattuck (2012). These characteristics were used to concretise DBR for this study (see Table 2.2).

Table 2.2

Characteristics of Design-Based Research

Characteristic	Concretised in this study
Focusing on the design and testing of a significant intervention/artefact/theory	The aim of the study is to design and evaluate a M-MLI for a formal teacher in an educational context
Offers new educational knowledge about teaching and learning	The study provides the fundamental elements and factors of using mobile devices in teaching and learning
Being situated in a real educational context (Grounded)	A M-MLI was developed and conducted in an authentic educational context where the pre-service teachers used their mobile devices (using Padlet Wall, a technological tool) as part of the teaching and learning practices.
Using mixed methods/integrative	DBR is situated in real educational contexts, focusing on the design and testing of interventions using mixed methods, involving multiple iterations, a collaborative partnership between researchers and practitioners, the development of practical design principles, how this differs from action research and how it impacts practice. A review of literature, fact-finding study collaboration with practitioners (Phase one of DBR) represents the quantitative aspects of the study while three iterative cycles of mobile mediated learning interventions (Phase two of DBR) represent the qualitative aspects of the study. As a result, DBR was employed as the research strategy which required different and integrative methods.
Involving multiple iterations	The study included three iterative cycles of M-MLI. A pre-service teacher survey and interviews with educators and IT practitioners were used to obtain data for the fact-finding study. While student artefacts, the Progress Report Journal (PRJ), discussion forums, pre- and post-evaluation surveys, and observations were used to collect data during the M-MLI iterative cycles.

Involving a collaborative partnership between researchers and practitioners/interactive	Educators, IT educators and pre-service teachers' participation, collaboration and feedback played a crucial role in the design and development of the M-MLI.
Evolution of design principles/pragmatic	The study refined both theory and practice. A mobile mediated action learning framework and design elements for advising mobile devices integration in teaching and learning were designed, refined and developed.
Grounded	The initial design guidelines of M-MLIs were constructed based on the elements of authentic learning, the mobile learning literature and hermeneutics theory. Hence, the theory was inextricably tied to the design of the M-MLI.

2.5 Why using Design-Based Research in this Study

This study is situated in an authentic pre-service teachers' educational context, using student-owned mobile devices and a mobile application called "Padlet."[5] The main reason for adopting DBR was to design and test solutions to develop design principles that could be used to guide pre-service teachers' mobile-mediated learning experiences. In a nutshell, DBR was adopted for this study to enable the design and development of design principles to support mobile device implementation in teacher education as well as advance mobile learning theory. Through DBR, pre-service teachers were given an opportunity to develop their reflective capacity on mobile learning through mediated learning experiences as narrated by Gadamerian's HLE on how to develop new horizons. This enabled me to perform an iterative and flexible modification of the research design, incorporating research methodologies from both qualitative and quantitative research (Dede, 2005).

To construct the design guidelines, I aligned the Gadamerian HLE theory, Revans' AL theory, and DBR. The aforementioned were relevant in carrying out a well-informed learning design for pre-service teachers, with a special emphasis on reflections and creative mobile learning pedagogical activities. Thus, mobile-mediated pedagogical learning experiences are a key aspect of the research, and reflection is an important part of the study's findings.

[5] A Padlet is "a platform in which you can create a single or multiple walls that are able to house all the posts you want to share. From videos and images to documents and adios, it is literally a blank slate. It's collaborative, too, allowing you to involve students, other teachers, and even parents and guardians" Edwards, L. (2022). *Padlet digitizes the notice board for a rich media space that makes education communications better*. Tech & Learning. https://www.techlearning.com/how-to/what-is-padlet-and-how-does-it-work-for-teachers-and-students

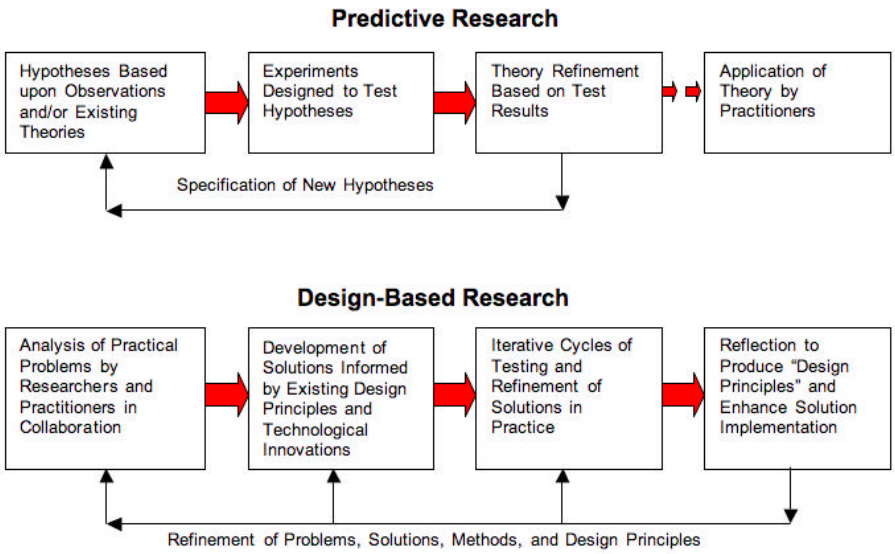
Subsequently, both quantitative data (collected from a fact-finding study, Phase One of DBR) and qualitative data (collected from three iterative cycles of M-MLI) using various data collection instruments were gathered. In partnership with practitioners, a fact-finding/pilot study (quantitative data) was initially done to explore pre-service teachers' prior experiences (prejudices) and biases towards mobile learning. To represent the post-experiences of pre-service teachers (fusion of horizons), a technological intervention using Padlet was conducted through observation, questionnaires, and students' artefacts such as transcripts of chats from the Padlet wall, blogs, and discussion forums.

2.6 Description of the four phases and processes of Design-Based Research (DBR)

Design research is an iterative and lengthy process that can be viewed as four connected phases, as described by Reeves (2006). DBR strives to tackle real-world problems through cyclical research processes in conjunction with researchers and practitioners (Koivisto et al., 2018). It also combines research and design (Bell, 2004), which is important when designing and developing new educational technology (Koivisto et al., 2018).

Figure 2.4

Predictive and DBR approaches in educational technology research Source



Note: This figure illustrates the four phases of a design-based research. From "the learning leader; how to focus school improvement for better results," by D.B. Reeves, 2006, Vol.21, p 59. Copyright 2006 by Portland: Ringgold, Inc.

This study employed design-based research (DBR) to analyse, design, develop, test, and refine mobile-mediated learning design principles for pre-service teachers. It was guided by the four phases of DBR (see Figure 2.4). Each of these four phases is discussed below, as well as the practical issues in each phase and how they were utilised in this study.

2.6.1 PHASE One: Analysis of practical problems by researchers and practitioners

The first phase of the DBR encompasses defining the problem, consulting practitioners and researchers, reviewing the literature, and posing research questions (Stemberger & Cencic, 2014). As a guide to present the DBR Phase One, Herrington et al. (2010) identified four key processes and products that form the first phase of DBR. These are as follows: (a) *the problem*; (b) *the practitioners*, (c) *the literature review and (d) the creation of research questions*.

The problem

Through the collaboration of the researcher and practitioners, the researcher will first identify and investigate significant educational problems or challenges (Reeves, 2006). A practical question to consider is: "*What is the educational problem that the researcher will address*?" (Herrington et al., 2010, p. 173). A research problem must be precisely defined (Stemberger & Cencic, 2014). It can be a real-life educational problem facing students (McKenney & Reeves, 2012), and relate to a practical problem and an actual search for a potential solution (Stemberger & Cencic, 2014). A solution can be a technology-based intervention, an educational game, an e-learning site, or a technology tool (Miller, 2012).

Practitioners

It is important for *practitioners* and/or participants (such as experts, educators, lecturers, and pre-service teachers) to work in collaboration with the researcher during this phase of investigating the educational issue or problem facing students (Herrington et al., 2010). According to Amiel and Reeves (2008), the practitioner is an important partner in creating research questions and identifying problems that require investigation. The questions to consider during the negotiation of research goals between practitioners and the researcher can be: *Who are the lecturers/students/practitioners that are knowledgeable about or 'own' the problem? What data will be collected from these practitioners? What questions will be posed*? *How will this data be analysed*?

(Herrington et al., 2010). In such instances, the research problem is fully defined in collaboration with practitioners.

Literature review

The study problem cannot be properly defined and explored without conducting a *literature review* to refer to previous work that has already been done in a similar area or related educational problem and challenges (Reeves et al., 2011). The DBR approach allows for the formulation of draft design guidelines that inform the design and development of the intervention that will strive to address the identified problem, as well as the development of a potential solution (Herrington et al., 2007). A question such as: "*What are the important references/literature in the area of interest*?" can assist in understanding how similar problems might have been addressed in another or related discipline (Herrington et al., 2010).

Creation of research questions

Lastly, after the initial investigation of the problem, the review of related literature and practitioners' ideas and perceptions provide the basis to *create research questions* that lead to the research (Herrington et al., 2010). For that purpose, the researcher should clearly describe the educational research problem and its context, a literature review, a summary analysis of practitioners' perspectives, and develop preliminary research questions (Herrington et al., 2010) at the end of Phase One of DBR. Thus, I describe below how DBR Phase One was applied in this study.

How Phase One of DBR was applied in this study

This study began with a review of related literature, followed by an initial fact-finding study including pre-service teachers, educators, and Information and communication Technology (IT) practitioners (educators), as specified in the first phase of the design process presented above. The purpose of reviewing literature (see Chapters Three and Four) was to explore and identify the educational challenges that revolved around mobile learning, as well as to guide the development of preliminary research questions. Following the exploration and identification of the research problem from the literature, a fact-finding study (explorative) (see Chapter Five) was designed to seek practitioners' (educators under the Faculty of Education, ,educators from the Information and communication technology department in this study they are called IT practitioners or educators (educators who are teaching IT subjects for pre-service teachers e.g. IT skills

for teacher), and all third-year students/pre-service teachers doing secondary education at IUM) views and prejudices regarding the integration of mobile devices into teaching and learning.

The fact-finding study was conducted via Google Forms (questionnaires) for the pre-service teachers and Zoom teleconferencing for the informal interviews with educators and IT practitioners. Following the exploration and identification of the research problem in collaboration and consultation with practitioners, as well as a review of related literature (such as Mobile Learning, HLE Theory, and AL Theory), I updated preliminary research questions that are aligned with the theoretical and conceptual framework of this study (see Chapter One). As a result, the created research questions prompted the development of design guidelines, the identification of practical solutions, and the implementation of this study's proposed technological intervention. The following section discusses Phase Two of DBR, which is the design of practical solutions to the research problem.

2.6.2 Phase Two: Development of solutions informed by existing design principles and technological innovations

The **second** phase of the DBR encompasses the preparation of a theoretical framework, the development of indicative guidelines for designing intervention, and drafting a description of the interventions proposed for lessons (Stemberger, 2014). During this phase, a solution to the problem or an intervention that may be implemented in the educational setting is proposed, which was guided by the elements of authentic e-learning (see, Herrington, 2010). Following Herrington et al., ’s (2010) guide to authentic e-learning process of DBR Phase 1 in the preceding section, I continued with a description of their proposed process and steps to guide the application of DBR Phase 2. These steps are: (a) drafting principles in the literature, (b) technological affordance, and (c) the design of the learning environment.

Draft principles in the literature

The outcomes of design-based research are the design principles generated based on the knowledge and experiences gained through the research process (Wang & Hannafin, 2005). Because educational technology is a design field, its paramount research goal should be to solve problems in teaching, learning, and performance, as

well as to derive design principles that can inform future development and implementation decisions (Reeves et al., 2004). Hence, in order to produce a solution to the research topic, the researcher reviews the literature once more to identify the relevant theoretical framework that might guide thinking as well as locate current design principles that may have tackled the identified similar problem (Herrington et al., 2010). Design principles "can refer to characteristics of a planned learning design (what it should look like), or its procedure (how it should be developed)" (Herrington et al., 2009, p. 130). Design principles are frequently presented in a form that lists criteria for particular learning environments and outcomes (Herrington et al., 2009), and they are a verb to ensure that each design principle can be linked to an action or activity in the learning context (Reeves et al., 2011).

At this point, the literature review should be revisited in order to uncover existing design principles or guidelines that other researchers have already offered for particular circumstances or outcomes (Lautenbach, 2014). Such design principles are not fixed so they can be revised and refined (Herrington et al., 2009). The questions to consider at this stage are: *What are the most relevant research papers that provide design principles or design advice? What learning theories or approaches are most helpful in addressing the problem? What are the draft principles to guide the design of the solution?* (Herrington et al., 2010). To this end, a list of draft existing design principles was produced to guide the design solution to the research problem investigated in Phase One of DBR.

Technological affordance

Once the draft design principles have been created, it is critical to consider the best strategy to deliver or operationalise the intervention within the online collaborative learning environment (Herrington et al., 2010). DBR approaches engage interventions with technological affordances that are useful in supporting students' online collaborative learning processes (Reeves, 2006). Therefore, a researcher has to think about technologies that may be valuable for students to use as cognitive tools as well as for content delivery, such as computer programmes, websites, and mobile technologies (Herrington et al., 2010) and collaborative tools such as Padlet. The question to consider at this stage is: *What technologies appear most useful for operationalising or implementing the intervention?* Answering that question brought me to the appropriate selection of the tool that matched the mediation of mobile learning

and its affordances. As Ng'ambi and Brown (2015) emphasise, the use of emerging technologies to mediate learning presumes that its affordances are aligned with the design of the task or environment, are socio-culturally relevant, and that the subject will focus on the object of the activity while technology is invisible. The following section is the final step of DBR Phase Two, the design of the learning environment.

Design of the learning environment

By the end of the DBR Phase Two, the learning environment or intervention is designed and developed, which is guided by the draft design principles (Herrington et al., 2010). In fact, a solution to the problem will have been planned, created, and it will be ready for implementation in the online learning environment (Herrington et al., 2010). It is important, however, for the researcher to consider how each of the design principles will be instantiated and implemented in the learning environment.

How Phase Two of DBR was applied in this study

For this study, design principles were crafted using the existing design elements of authentic e-learning based on AL and HLE theories to guide the design of my intervention, in accordance with the recommended steps for implementing DBR Phase Two described above (see Chapter Seven). The nine elements of authentic learning which are based on Herrington and Oliver's (2000) situated learning theory were preferred as the guiding design elements for this research that emerged from the literature. Out of nine guiding elements of authentic learning, only five elements were adopted, tested, refined, and deemed important for this study.

Furthermore, the preferred and selected technological tool for this study is a Padlet. A Padlet is defined as "a website that provides users with a digital canvas. The user can post text, videos, and images from a mobile device or a desktop" (Zakime, 2017, p. 1). One of the great affordances of Padlet for mobile-mediated learning use is the fact that many students can post to the same wall at the same time, thus making it ideal for collaborative work and the creation of projects (Zakime, 2017, p. 1). The online Padlet "wall" can be displayed during the lecture, thus allowing immediate comments, images, or hyperlinks posted by individual students to be shared during the lesson with the entire class (Ellis, 2015). A Padlet can also be used as a tool to encourage collaboration outside the classroom. Homework and assignments from different students such as

text, images, videos, and audio can be posted on the wall from anywhere and at any time outside the classroom (Zakime, 2017).

Therefore, my choice of using Padlet for this study is for the following reasons: *Firstly,* it is a free application; and *secondly,* pre-service teachers can access the Padlet wall from any mobile device via a standard web-browser, thus making the tool relatively easy to use without any prior preparation, such as installing the App or so. *Thirdly,* the Padlet supports mobile-mediated learning through collaborative activities in real time that allow pre-service teachers to reflect on their dialogical activities to create new meanings, experiences and conclusions. *Finally,* the Padlet enabled the operationalisation of the design elements of authentic learning to mediate mobile learning among pre-service teachers.

Once a practical solution to the problem or intervention (of mobile mediated learning experiences) has been designed and developed (in DBR Phase Two), the next phase of DBR is the implementation and evaluation of the proposed solution in real-world educational practice. The next section presents Phase Three of DBR, which is the implementation and evaluation of practical solutions to the research problem.

2.6.3 Phase Three: Iterative cycles of testing and refinement of solutions in practice

The third phase of DBR, according to Herrington et al. (2010), involves the introduction and implementation of the proposed intervention/solution (in DBR Phase Two) into practice (first iteration) and those participating in the research, data collection, and analysis, followed by a repeated implementation of the intervention into lessons (second iteration and more) (Stemberger & Cencic, 2014). During this phase, the primary focus is on an iterative approach to developing new learning theories, artefacts, frameworks, design knowledge, and practices in a real educational context to provide a sense of validity to the research and ensure that the results can be effectively used to improve both educational practice and research (Barab & Squire, 2004). On the other hand, “one must take into account the fact that design-based research is cyclical and that one implementation alone rarely suffices as an adequate assessment of the success (or failure) of the introduction of innovations into lessons” (Stemberger & Cencic, 2014, p. 67). Therefore, DBR requires at least two cycles of testing, but usually more, and each

iteration (cycle) must involve participants, data collection and analysis of data, and strategies chosen in relation to the research questions (Herrington et al., 2010).

A typical design research study on the other hand would have two or more iterative cycles of testing, where changes are made to the learning design after the first implementation and evaluation to further improve its ability to address the problem and, based on the findings, go on to implement innovations into lessons anew (Herrington et al., 2010). During Phase Three of DBR, relevant questions include: *Who are the study participants? How will the solution be implemented with the students in the e-learning course? What data will be collected to answer the research questions? How will the data be analysed*? (Herrington et al., 2010).

As per aforementioned, DBR is clearly interactive, iterative, and flexible (Rikala, 2015a). As a result, researchers can collect data in cycles that last several weeks, months, or even years, and data collection methods typically change between research cycles (Stemberger & Cencic, 2014). Thus, “one can expect a triangulation of sources of information (e.g., teachers, students, parents), of data collection techniques (interviews, observations, polling), and of researchers (the researcher himself/herself, teachers, assistants, or collaborators)” (Herrington et al., 2007, p. 8).

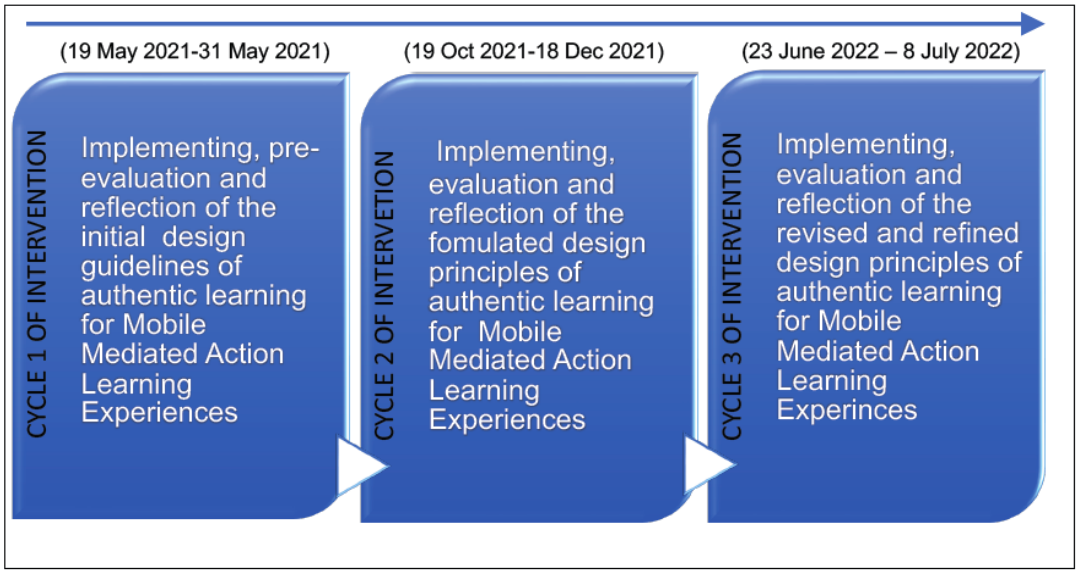
How Phase Three of DBR was applied in this study

Based on the identification of the research problem on mobile learning (Phase One) and the formulation of design solutions or intervention guidelines to address the problem (Phase Two) of this study, the designed intervention M-MLI was implemented into three iterative cycles of testing, evaluation, and refinement (Phase Three). Each design cycle involves a selection of participants (pre-service teachers or students), data collection (qualitative), and data analysis procedures. During this phase, the M-MLI for reflection in learning was conducted, which helped to identify the challenges that influenced pre-service teachers' use of their own devices for M-learning. Here, the drafted design principles were tested and refined with a few selected (a group of six to eight students) third-year pre-service teachers based on their areas of subject specialisations such as commercial subjects, science subjects, social sciences subjects, and languages as previously stated.

The M-MLI design guidelines that were framed within the elements of authentic learning were evaluated and reflected on, and revised iteratively throughout the individual study. Three iterative cycles of the Padlet wall usage were considered to inform the redesign of subsequent iterations. Participants were encouraged to engage in collaborative activities on the Padlet wall, and data were analysed in different ways to respond to the research questions. The first design cycle of the M-MLI was largely based on (a) testing the five existing design guidelines (elements of authentic learning) derived from the literature; (b) early trials of Padlet application affordance, which enabled participants (pre-service teachers) to address their prejudice and to reflect on their experiences of mobile-mediated learning; and (c) observing, analysing, and understanding the research problem in a specific real-world educational context. At the conclusion of M-MLI cycle one, the findings were analysed and reported (see Chapter Eight), and recommendations for the next cycle were made. The second design cycle of the M-MLI was done following the recommendation from cycle one. Here, the initial existing design elements of authentic learning were modified, refined, and re-tested based on M-MLI cycle one feedback.

Figure 2.5

Mobile-Mediated learning intervention process for the study



Note: Graphical depiction of the iterative cycles of implementing, evaluation, reflection and revision of the mobile-mediated intervention (M-MLI) for the study. Own work.

The findings and discoveries made in the second cycle of M-MLI were again analysed and recommendations were suggested that provided the basis for implementation of cycle three (see Figure 2.5). It is important to note that each implementation of the cycle

resulted in further modifications to the design elements of authentic learning and the Padlet intervention. These modifications were influenced by what worked and what did not work during the implementation of each cycle of M-MLI. These iterative cycles addressed research questions two, three, and four of this study.

2.6.4 Phase Four: Reflection to produce design principles and enhance solution implementation

The fourth and final phase of DBR, according to Herrington et al. (2010), involves "reflection on the entire process to produce design principles that can inform future development and implementation decisions" (p.180). This phase "brings results, solutions to the posed problem, and the final design of intervention in lessons, thus signifying the conclusion of the research, which can include the designing of principles/artefacts, teaching methods, teaching aids, a designed learning model, etc., and concludes with the professional development of those involved" (Stemberger & Cencic, 2014, p. 68). Following Herrington et al.'s (2010) process of DBR phases in the preceding sections, I continued with a description of their proposed three useful outcomes of design-based research that can be produced during DBR Phase Four. These outputs are*: (a) scientific output (for example, design principles); (b) practical output (for example, designed products or artefacts); and (c) societal output (for example, professional development and learning)*.

Scientific output: Design principles

A typical element of design-based research, and one that sets it apart from other research approaches, is the production of design principles to advance both practical and theoretical understanding of the research problem (Herrington et al., 2010). Design principles "contain substantive and procedural knowledge with a comprehensive and accurate portrayal of the procedures, results, and context, such that readers may determine which insights may be relevant to their own specific settings" (Herrington et al., 2007, p. 7). As a result of the findings from DBR Phase Three, the draft design principles may need to be refined, revised, reorganised, merged, or possibly new design principles may be developed (Herrington et al., 2010). For example, after the implementation and evaluation of the M-MLI (three iterative cycles), the draft design principles that have guided the design of the intervention were revisited, refined, and finalised for this study.

Practical output: designed products or artefacts.

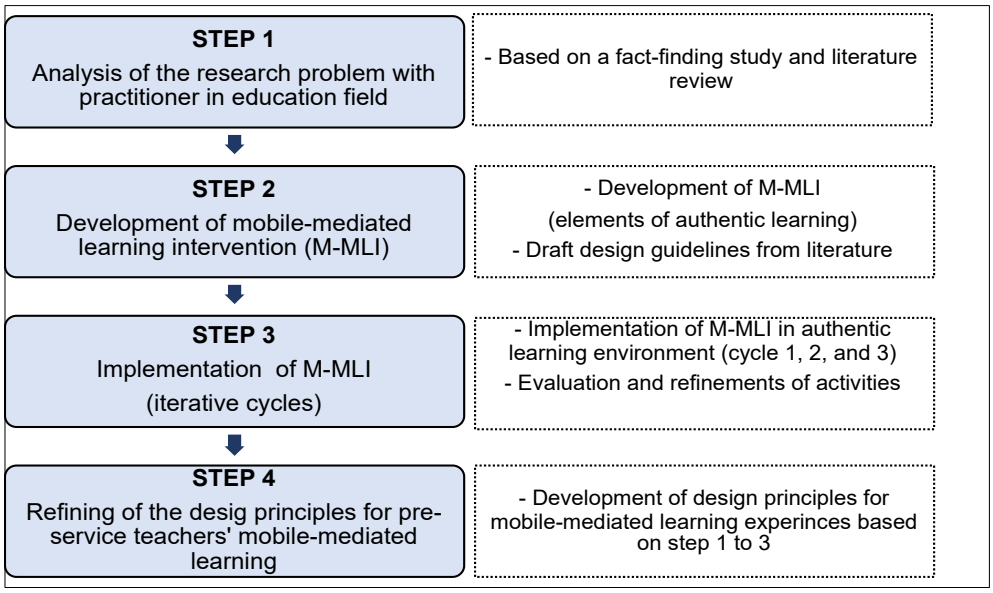
In design-based research, the dominant research goal in educational technology should be to solve teaching, learning, and performance challenges (Herrington et al., 2007). The intervention that is designed and implemented in design research is frequently a computer-based or technology-based product that might be widely published or shared. Hence, the product or artefact of design-based research is regarded as a significant output (Herrington et al., 2010). A Padlet wall, for example, was employed as a technological tool for this study, and participants posted teaching materials, podcasts, etc., which are called design products or artefacts.

Societal outputs: Such as professional development of participants

Collaboration with practitioners, which is fundamental to the process of developing and carrying out a design-based research project, has an added benefit in that it enhances the professional development of all participants (Herrington et al., 2007). This study, for example, included IT practitioners, pre-service teachers, and educators who may have gained knowledge and skills during the M-MLI processes.

Figure 2.6

Four steps of a design-based research process of the study



Note: This figure shows how the process of DBR was applied and followed in the study. Own work.

How Phase Four of DBR was applied in this study

The last phase of this study involved using the reflections from the three iterations, that is, authentic learning tasks and the empirical evidence collected to refine, evaluate and develop the design principles for a pre-service teachers' M-MLI. In this sense, the drafted design principles that guided the development of the M-MLI were implemented, revisited, and refined, and finally the design principles for mobile-mediated learning experiences of pre-service teachers were developed (see the whole process in Figure 2.6).

Description of Participants and Settings

This study, which enabled the development and evaluation of design principles for a M-MLI, was conducted in a private institution of high learning in Namibia, the International University of Management (IUM). The focus of the learning activities involved authentic learning tasks and guiding elements. Following the phases of DBR, the study started with a literature review, followed by initial (explorative) fact-finding studies involving both educators and pre-service teachers (students) at IUM (see Chapter Five). Following the fact-finding study, an M-MLI was developed and three iterative cycles of data collection, analysis, and evaluation were employed.

The educators' (lecturers') and pre-service teachers' perceptions and preconceptions of mobile devices in teaching and learning were explored as part of the fact-finding study to determine the practical problem for this study. The primary data collection consisted of six educators teaching IT courses and teaching methodology courses who were purposively selected for the study. A semi-structured interview was administered as "this form of interviewing allows the researcher and participant to engage in a dialogue whereby initial questions are modified in the light of the participants' responses and the investigator is able to probe interesting and important areas which arise" (Smith & Osborn, 2015, p. 57).

In parallel, an online survey was also administered for pre-service teachers pursuing their studies under the Faculty of Education, towards a Bachelor of Secondary Education Honours, who are still studying and receiving practical teaching training. All students in the 3rd-year class (n = 195) were given the opportunity to participate in the online survey, which was sent to them via student emails, and 114 responded positively. This group was selected to determine pre-service teachers' knowledge and

perceptions of mobile learning. In fact, the courses selected for this study intervention are teaching methodology modules for commerce, science, social sciences, and language subjects, and they are third-year modules that are intended to prepare students for teaching the pedagogical practices of their specialised subjects. Hence, interviews were administered in order to assess and diagnose educators' existing pedagogical practices as well as their usage of practical educational design tools in their teaching practices. While a survey was undertaken to learn about pre-service teachers' experiences with mobile learning and digital learning. It also provided me with the opportunity to gradually clarify and explore the pre-service teachers' problem, the characteristics of its potential solution, and the identification of technological tools and applications that appear most useful for implementing the M-MLI as DBR postulated.

Descriptive statistics and thematic analysis were used in the analysis of the fact-finding study data obtained. Descriptive statistics were used for analysing the data gathered through the Google Form Survey. A thematic analysis was used for analysing interview transcripts and open-ended questions using a Microsoft Excel sheet to sort, categorise, re-read, and code categories according to the themes that emerged from the data.

For the iterative cycles of an M-MLI, the implementation of cycles one, two, and three of the intervention consisted of eight (8) pre-service teachers (the focus of Revans' action-learning premise) per cycle, which gave me a total sample of 32 participants who were involved in questioning and problem-solving using their mobile devices. Each participant took part in and reflected on a mobile-mediated action learning activity based on their specialised school subject areas (commerce, science, social sciences, and languages). During the intervention, the IT practitioners assisted me with technical aspects such as setting up internet connectivity and exploring the Padlet affordances. The following section describes the process of data collection and analysis employed for the implementation of M-MLI.

Description of Data Collection/Procedures (Iterative Cycles)

A fact-finding study (Phase One of DBR; survey and interviews) and the development of drafted design guiding elements for a mobile-mediated action learning intervention (see section 2.6 of this chapter, Phase Two of DBR). Table 2.3 presents how the three iterative cycles of M-MLI were conducted to implement, test, and refine the design solution in multiple ways. This offered an opportunity for participants to engage in

multiple frames of reference through dialogue, comments, and reflection in team settings (Yeo & Gold, 2011). Therefore, a dedicated Padlet "wall" was created prior to each iterative M-MLI cycle and participants were invited to join my Padlet. For each cycle, five main authentic learning activities were developed for the participants and posted on the Padlet wall prior to each session. Participants were given two to three days to complete a task. Data were collected through pre- and post-evaluation questionnaires, observations, posts transcripts/participants' artefacts on the Padlet, PRJ from each session, and focus group discussions/interviews during an iterative process of questioning and implementation of M-MLI.

During the implementation of each cycle, participants were posting their queries, comments, and tasks on the wall, and other students were commenting and discussing through dialogue as a process of learning experiences. My role as a researcher/educator was to coach, guide, and scaffold participants during the session. Mental consciousness can then be explored and constructed through the process of reflection (Jacobs, 2014) and by relating the abstract world to the physical world. This allowed the participants to consider how similar practices might be managed in the future classroom with the help of the group and a coach (see James, 2018, p. 877).

The reflection and evaluation processes of the M-MLI, both reflection in-action and on-action, were facilitated through the provision of authentic tasks that required considerable decision-making in their completion and through the writing of reflective artefacts. The final stage of the process is to reflect on what participants accomplished and learnt by evaluating the business impact of the solutions and their previous activities. At the beginning of each session, participants were required to complete a pre-evaluation questionnaire containing questions about their previous experiences and perceptions of mobile learning, Padlet, and the use of mobile devices in teaching and learning. At the end of each session, participants were required to complete a PRJ to record their experiences of each session of the cycle. At the end of each M-MLI cycle, participants were required to complete a post-evaluation questionnaire containing questions about their experiences of using a Padlet, and its contribution to their mobile-mediated action learning experience. This was to explore the key issues emerging from the reflective elements.

Table 2.3

Data collection procedures and tools employed for each cycle of M-MLI

Intervention sessions	Cycle One	Cycle Two	Cycle Three
Authentic Tasks/ activities on a Padlet	***Five tasks (Ts) were developed:*** **T1**: Install Padlet and post self-introductory voice note, complete a pre-evaluation questionnaire and sign a consent form **T2**: Search for teaching material from Google search, YouTube websites, Flickr and post to the Padlet **T3**: Create YouTube accounts and develop a YouTube online lesson and post to the Padlet **T4**: Create a sample evaluation questionnaire using google forms **T5:** Reflection on the intervention cycle one	***Five tasks (Ts) were developed:*** **T1:** Install Padlet and post self-introductory voice note, complete a pre-evaluation questionnaire and sign a consent form **T2:** Develop a tutorial video on how to use any two features of Padlet and post it on the wall; review each other's' video and comment. **T3:** Create and post a sample Google site called M-MLI Cycle Two. Post the sample website link to the Padlet for participants to access **T4:** Comment on each other's websites and share more ideas on how to populate their websites via Padlet. **T5:** Cycle one participants create a post-evaluation questionnaire for the new participant to complete New participants to complete the post-evaluation questionnaire, sharing their experiences and challenges from the M-MLI cycle two	***Five tasks (Ts) were developed:*** **T1:** Install Padlet on their mobile devices. Sign a consent form and complete a pre-evaluation questionnaire ***T2:*** Explore the features and benefits of Padlet Develop a tutorial video on how to use any two features of Padlet Review each other's videos and comment ***T3:*** Create websites for their specialised subjects using Google Sites Populate and customise their website by adding content from their school's specialised subject Post their website links on the Padlet wall for others to access them **T4:** Comment on each other's websites and share more ideas on how to populate their websites via Padlet **T5:** Participate in a Forum discussion via Padlet, share their experiences, and skills acquired, as well as re-evaluate their perception of mobile-mediated learning
Data collection and procedures	Pre-and- post evaluation questionnaires Observations Posts transcripts Participants' artefacts PRJ (Feedback from every session)	Pre-and- post evaluation questionnaires Observations Posts transcripts Participants' artefacts PRJ (Feedback from every session)	Pre-and- post evaluation questionnaires Observations Posts transcripts Participants' artefacts, Forum discussion PRJ, (Feedback from every session)

Authentic Learning Environment	Tasks were posted to the Padlet wall by the researcher Researcher notifies and reminds participants via a WhatsApp group daily Participants given two to three days to complete the tasks Researcher scaffolded, modelled and monitored participants' progress Participants assisted each other to complete the tasks	Tasks were posted to the Padlet wall by the researcher and participants from cycle one Researcher and participants from cycle one notifies and remind participants via a WhatsApp group daily Participants given two to three days to complete the tasks Researcher and participants from cycle one scaffolded, modelled and monitored participants' progress Participants assisted each other to complete the tasks	Tasks were posted to the Padlet wall by the researcher and one participant from cycle one and two Researcher and one participant from cycle one and two notify and remind participants via a WhatsApp group daily Participants given two to three days to complete the tasks Researcher and one participant from cycle one and two scaffolded, modelled and monitored participants' progress Participants assisted each other to complete the tasks
Reflection and Evaluation	Post-evaluation questionnaire was developed and completed at the end of the cycle Participants post their experiences on a PRJ at the end of each session Participants discussed their experiences on a Padlet at the end of the cycle	Post-evaluation questionnaire was developed and completed at the end of the cycle Participants post their experiences on a PRJ at the end of each session Participants discussed their experiences on a Padlet at the end of the cycle	Post-evaluation questionnaire was developed and completed at the end of the cycle Participants post their experiences on a PRJ at the end of each session Participants discussed their experiences on a Padlet at the end of the cycle
Data Analysis	Thematic analysis/Textual analysis	Thematic analysis/Textual analysis	Thematic analysis/Textual analysis
Number of participants and duration	Number of participants: 8 Duration: 19 May 2021-31 May 2021	Duration: 19 Oct 2021 to 18 Dec 2021	Duration: 23 June 2022- 8 July 2022

Description of Data Analysis (Iterative Cycles)

A hermeneutics cycle-driven analysis was adopted as a textual analysis for this study. According to Gadamer's hermeneutic theory (*a theorist that provides the language for this study*), it is important to note that for the hermeneutic circle to be fully experienced, cyclical feedback and discussions must take place (Fleming et al., 2003). In line with this view, the "concept of naive and depth interpretation fits well with the hermeneutic notion that understanding the parts of the text, in relation to the whole, and the whole of the text, in relation to its parts, represents the many levels of interpretation through which interpreters proceed in their endeavor to interpret a text" (Geanellos, 2000, p. 118).

Therefore, for this study, the notion of hermeneutic cycle-driven analysis was taken into account, especially in relation to: (i) the conversations between the researcher and participants (during the first phase of DBR), which were recorded via Zoom and transcribed verbatim to capture the historical moment and provide a text with which to engage in dialogue (Fleming et al., 2003), and (ii) enabling interpretive textual analysis to guide the faithful representation of a text by providing that text with every opportunity to reveal its truths (Geanellos, 2000). Hence, for effective textual analysis of this research, data collected from iterative cycles of mobile-mediated learning experiences were analysed using themes, and issues were identified and integrated by grouping similar themes into broad categories. Specifically, codes were tentatively assigned to each issue or text within a response, and comments were then sorted to identify similar words, phrases, and sequences of ideas to identify patterns of responses.

The textual analysis involved reading through the transcripts to create themes, and then re-reading the transcripts to outline categories specific to each theme (Ng'ambi & Lombe, 2012). Therefore, transcripts (such as posts on the Padlet, chats, PRJs, interviews, open-ended questions) and categories were analysed to identify data relating to each identified category. The transcripts were then coded according to categories. The researcher therefore facilitated the change of understanding (fusion of horizons) among the pre-service teachers, and the findings of the study were written up using the selected quotations to illustrate themes.

Ethical Considerations

In this study, ethical guidelines as stipulated in the University of Cape Town (UCT) code for research were adhered to. Ethical clearance was obtained from the Faculty of Humanities, School of Education, before conducting the study. Participants for this study were pre-service teachers (human subjects) at the International University of Management (IUM) in Namibia. A permission letter to conduct the research at IUM with pre-service teachers doing their third or fourth-year Bachelor of Education in Secondary Honours was obtained from the university's ethical committee. The researcher also informed participants of the aims and implications of the research project and of any other considerations which might reasonably be expected to influence their willingness to participate. When conducting a research study as a lecturer and involving students as participants, ensuring trustworthiness was of utmost importance. Trustworthiness refers to the credibility, dependability, and authenticity of the research findings and the researcher's actions. Therefore, as a researcher, I communicated my roles and responsibilities of being both a lecturer and researcher. I ensured that participants understood that their participation in the study would not affect their academic standing, grades, or their student-lecturer relationship.

On the other hand, consent forms were distributed and shared among the participants to indicate their willingness to participate in the study. In addition, the confidentiality and anonymity of the participants in this study were maintained at every stage of the research. Participation in this research study was voluntary and refusal to participate did not lead to any consequences. Participants in this study were also allowed to withdraw from the study at any time with no consequences.

2.7 Chapter Summary

In this chapter, DBR was adopted as an appropriate methodology, focusing on a systematic procedural process that is illuminated in addressing the research problem and developing the learning solution. Furthermore, the process of designing this study was presented. An illustration of how the DBR methodology was applied and its justification for this study was highlighted. The chapter concluded with the description of the four phases of the DBR and how they were applied throughout the entire thesis. The following chapter (three) presents the revolution of emerging technologies in pedagogy and mobile learning as key concepts of this study.

CHAPTER 3: EVOLUTION OF EMERGING TECHNOLOGIES IN PEDAGOGY AND MOBILE LEARNING
(DBR: PHASE ONE)

3.1 Chapter Overview

Consistent with DBR, this chapter presents Phase One of DBR which discusses the review of literature evolving around mobile learning before the consultation of practitioners and educators in collaboration to define the research problem. The chapter describes the evolution of emerging technologies in education and mobile learning as a way of transforming education through digital technologies.

3.2 Emerging Technologies (ETs) in Education: Demand of a 4th Industrial Revolution (4IR)

We live today, in the era of technological connectedness, which is well known as the Fourth Industrial Revolution (4IR). It is widely said that the 4IR is characterised by a fusion of technologies that is blurring the lines between the physical, digital, and biological spheres (Yuhasriati et al., 2020). The fast-changing world, particularly in information technology, has changed the way people interact with the world as compared to the past three industrial revolutions (Yuhasriati et al., 2020).

3.2.1 Theorising the impact of the Digital Technological Era in Education

Digital technology is diffusing at an exponential rate across all sectors of the economy, including the education sector (Oke & Fernandes, 2020). The new elements of the fusion concept with regards to the 4IR can be discussed in terms of a new learning mode and of a new strategic concept (Kodama, 2018), transformation in technology-enhanced learning environments (George, 2011), transforming pedagogical practice (Lindsay, 2016; Ng'ambi, 2013), mobile learning environments (Ally et al., 2014; Dr Issham, 2011; Kritzenberger, 2013; Mohamed Osman & Johannes, 2010), and the implementation of e-learning in higher education (Yuhasriati et al., 2020), which is characterised by the cumulativeness of the innovations.

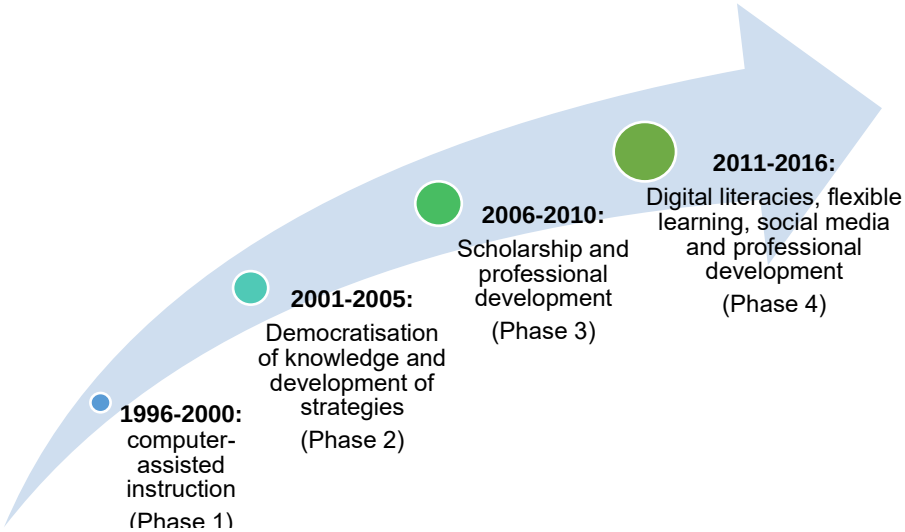
There is now compelling evidence about the disruptive capability of technology transformation in facilitating teaching and learning (Oke & Fernandes, 2020). Technology has a reciprocal relationship with teaching (Roy, 2019), for instance, social media platforms, including Facebook, Instagram, Twitter, Wiki, and Clubhouse (social networking app, launched in 2020), have entirely altered the fundamental building blocks of our society in the way people interact and communicate with each other

(Ng'ambi, 2013; Oke & Fernandes, 2020) using their mobile devices. The use of Web 2.0 technologies, Learning Management Systems (LMS) such as Moodle, Massive Open Online Courses (MOOCs), and other platforms are transforming the way teaching and learning are disseminated. In addition, emerging learning platforms such as WhatsApp (instant messaging tool), Skype (collaborative tool), etc. are increasingly becoming popular in supporting the teaching and learning process (see Ng'ambi et al., 2016).

The effect of the 4IR, specifically for the higher education (HE) institutions that prepare future teachers, is that they must always consider educational changes along with the development of technology (Yuhasriati et al., 2020). A study by Ng'ambi et al. (2016) presented an analysis of a 20-year journey review on how the digital networked/technological world influenced the shifts/changes in South Africa's HE teaching and learning. Their study also offered a view of trends and challenges in educational technology from a global perspective to a South African perspective that may also be useful in other developing contexts such as Namibia. They presented the analysis of 20 years of technology-enhanced learning in South African HE. Figure 3.1 shows how I divided these trends:

Figure 3.1

Twenty years of technology-enhanced learning in South- Africa reciprocal to Namibia



Note: This figure was developed by me to summarise the trends and challenges in educational technology from a global perspective to a South African perspective that may also be useful in other developing contexts such as Namibia, discussed by Ng'ambi et al., 2016. Own work.

According to Ng'ambi et al. (2016), Phase One (1996–2000) was a period of low information communication technology (ICT) infrastructure and technology was mainly used to increase productivity. Phase Two (2001-2005) concentrated on ICT infrastructure and research, primarily comparing the effectiveness of teaching with and without technology. In Phase Three (2006-2010), ICT infrastructure started to improve with mobile devices, mobile communication networks, and the use of ICT became part of institutional strategic directions. The last phase (2011-2016) was a period of high ICT infrastructure and an era of mobile learning and social media. The responses to Phase Four "will define the future of HE both globally and in South Africa for the next decade" (Ng'ambi et al., 2016, p. 852). Furthermore, the underlying question raised in Phase Four is:

> "What is the role of HE when the majority of students own mobile devices, are socially connected, digital content is freely available, and MOOCs are a buzzword? How will we proceed in the future?" (p. 853).

Technological advances offer a new paradigm in learning methods. The digital era conditions the way children and adolescents play, access information, communicate with each other, and learn (Komariah et al., 2019). In this context, the presence of teachers in the digital era with emerging technology requires a different teaching approach too. The teachers' important role in the future success of the education system, coupled with the availability of abundant technological mobile devices, requires the transition of HE institutions to a new learning environment to meet this challenge. The following section contextualises opportunities for transformative learning environments with emerging technology.

3.2.2 Redesigning the learning environment with Emerging Technologies (ETs)

There are international and national imperatives to implement emerging technologies (ETs) into teaching and learning to enhance learning that is fit for the purpose of the 21st century or 4IR (George, 2011). Emerging technologies (ETs) are conceptualised in this study as "tools, concepts, innovations, and advancements," intentionally defining "technologies" broadly to include not just tools and software but also concepts, such as pedagogies" (Veletsianos, 2016, p. 4). This perspective, in view of Veletsianos (2016), assumes that ETs are those that: (a) have not yet been widely adopted (mobile learning), and (b) are expected to influence a variety of educational settings (pre-service teachers' training). Bozalek (2011) argues that ETs are also seen to have a large impact on the future teaching, learning, or creative inquiry of higher education institutions (HEIs). In contrast, the new era assigns new challenges and duties to the

modern teacher (Roy, 2019) to make use of emerging technologies in teaching and learning. For instance, with the escalating demand for high quality education and the emergence of smart mobile phone technologies, educational institutions are taking other forms of learning (Padirayon et al., 2019).

With the impact enforced globally by the COVID-19 pandemic in all walks of life and endeavour, it has brought educators to the point of questioning the future of education – whether it needs to be redesigned, transformed, and to what extent. During the Future of Education Summit held on 29 July 2021, speakers grappled with this question: "How is education faring today, as the world, still in the thrall of the pandemic, faces challenges demanding more creative, innovative, and agile responses?" (FOESummit21, 2021). During the summit, it was also pointed out that although the 21st century brought with it a greater demand for flexibility, creativity, and agility, the education system lagged behind (FOESummit21, 2021). The COVID-19 pandemic has led to the temporary disruption of educational activities in the classroom (Butnaru et al., 2021). Pivots and consequences have been used as a great word to describe educational changes that have been enacted rapidly in the face of the COVID-19 pandemic (Scott, 2020). In view of the aforementioned, I posit that employing emerging approaches to education such as that of mobile learning, may necessitate the redesigning of new theories, models, and pedagogies that inform new learning environments to shape the future face of education through technology. Besides, the transformation brought on by the COVID-19 pandemic globally, across all parts of the economy, is likely to continue and can directly affect the continuation of education (Butnaru et al., 2021). Despite the pandemic crisis, educational institutions migrated from traditional (face-to-face) teaching activities to online learning activities to contain the spread of the SARS-CoV2 virus while teaching and learning continues.

Subsequently, in rethinking the structure of the digital learning environment, the effectiveness of online learning has shown several advantages due to increased flexibility and learning opportunities (Butnaru et al., 2021; Fullan, 2007). This has been prior to COVID-19, thereby causing researchers and practitioners to review various theories, models, pedagogies, and roles that are associated with emerging technologies to answer the question of how people learn in an emergent digital context. In a book titled *Emergence and innovation in digital learning* edited by Veletsianos (2016), that brought together researchers and practitioners in the field of emerging technologies and

emerging practices such as Ross and Collier ("Complexity, mess, and not-yetness: Teaching online with emerging technologies"); Anderson ("Theories for learning with ETs"); Kimmons and Hall ("ET integration models"); and Wellburn and Eib ("Multiple learning roles in a connected age: When distance means less than ever"), these authors contribute to a greater understanding of what exactly constitutes emergence in educational practices and theories.

According to Anderson (2016), learning and learning designs that use emerging technologies can be enhanced via the lens of history. Theories guide us to envisioning a new world, thereby helping us to make things and keep us honest (Anderson, 2004). Good theories are useful because they guide us in understanding and acting appropriately (Ng'ambi et al., 2015). In this light, Anderson (2004) outlined a few theories for learning with emerging technologies that consider how teaching and learning practices support new ways in which knowledge is created, shared, and refined pedagogical foundations, namely; (a) social constructivism; (b) complexity theory; (c) net-aware theories of learning; and (d) connectivism (see also Ozan, 2013). On the other hand, behaviourists, constructivists, positioned, combined, relaxed and enduring learning and teaching sustenance, have momentarily recognised six main theories and ranges of knowledge related to learning with portable technologies (Padirayon et al., 2019).

Each of the aforementioned theories proposes its own definition of what it means to learn, which, in turn, has implications for instructional practice, including the roles that teachers, students, and technology play in the classroom (Ertmer & Newby, 2016). The current study followed the notion of the constructivist paradigm, which proffers that an individual constructs his/her own understanding and knowledge of the world through experiencing things and reflecting on those experiences (Anderson, 2016; Padirayon et al., 2019). Constructivists also stress the contextual nature of learning and argue that learning happens most effectively when the task and context are authentic and hold meaning for the learners (Anderson, 2016). This perspective was best captured by Ertmer and Newby (2016, p. 61) when they practically outlined how learning with technology has interacted within the context of constructivism:

> *Learning process:* Participating in authentic experiences, interpreting the meaning of those experiences, and negotiating shared meaning with others.

Instructional strategies: Real-world problems, problem-based learning, case studies, apprenticeships/ internships and simulations

Role of teacher: Design meaningful contexts for authentic learning to be experienced by the learner, facilitate the learning by guiding student inquiry and providing constructive feedback, and take an active role while learning with the students

Role of learner: Engage in the learning process by applying existing knowledge and working collaboratively to solve meaningful problems

Role of technology: Can be used to access and analyse information about a meaningful problem, interpret and transform the information into personal knowledge, and then represent that knowledge to others.

On the premise, a constructivist perspective of learning was considered for a mobile-mediated experiential learning which was enabled through the authentic learning context for this study (this is clearly explained in section 3.4.3 of this chapter). The reciprocal relationship between historical theories of learning and technology practices for this study became clearer when I examined the interplay between the constructivist theory for learning and the development of mediated mobile learning practices that capitalised on that theory.

Moreover, just as theory is crucial for understanding the interplay between emerging technologies and learning, "theoretical models are essential for guiding thoughtful technology integration practices in existing educational contexts" (Kimmons & Hall, 2016, p. 51). The birth of various models and frameworks intended upon guiding meaningful technology adoption in both K-12 as well as in higher education settings has been increasing in recent years (Kimmons & Hall, 2016, p. 51). Kimmons and Hall define technology integration models as "frameworks that one can use to guide thinking around the use of emerging technologies in education and, as such, provide a way to examine the myriad ways stakeholders make decisions pertaining to technology use, adoption, and integration" (2016, p. 52).

Various frameworks/models have been developed as diagnostic tools to describe how teachers use emerging technologies in teaching practices (Tarling & Ng'Ambi, 2016). However, some of the models were not specifically designed to address the mobile

learning context, but rather how to integrate and adopt technology in teaching in general. Some of these models are (see Kimmons et al., 2020; Kimmons & Hall, 2016):

TPACK *(Technological Pedagogical and Content Knowledge) model:* A framework that defines different kinds of knowledge domains teachers need to become proficient for successfully integrating digital technology in teaching and learning processes. These domains are: content knowledge, pedagogical knowledge, pedagogical content knowledge, technological knowledge as well as technological content knowledge (Koehler et al., 2013; Mishra & Koehler, 2006).

SAMR *(Substitution Augmentation Modification Redefinition) model*: The model was developed by Ruben R. Puentedura in 2012 and it was intended to encourage (enhance) teachers to move from lower to higher levels of teaching and learning with technology (Hamilton et al., 2016), which can also be used to classify and evaluate M-Learning activities (Romrell et al., 2014).

RAT *(Replacement Amplification Transformation) model:* A framework that can be used with pre-service and in-service teachers to increase critical decision-making concerning integration of technology into the K-12 classroom and to determine if a particular technology use replaced, amplified or transformed practice (Hughes et al., 2006).

TIM *(Technology Integration Matrix):* This was created to provide a resource for evaluating technology integration in K-12 instructional settings, and as a tool for helping to target teacher-related professional development, which is comprises five characteristics of meaningful learning (Active, Constructive, Authentic, Collaborative, and Goal-Directed) and five levels (Entry, Adoption, Adaptation, Infusion, and Transformation) (Harmes et al., 2016).

TAM *(Technology Acceptance Model):* This model was developed to predict individual adoption and use of emerging ITs. It comprises two key variables of user motivation, which are: (a) *perceived usefulness*, defined as the extent to which a person believes that using IT will enhance job performance; and (b) *perceived ease of use*, is defined as the degree to which a person believes that using IT will be free of effort (Venkatesh & Bala, 2008).

MTAM (Mobile Technology Acceptance Model): This model was proposed by Ooi and Tan in 2016, which focused explicitly on mobile adopters, to confirm whether users have the intention to adopt emerging mobile innovations and thus fit the context of m-learning. The two key variables revised from the original TAM are Mobile Usefulness (MU) and Mobile Ease of USE (MEOU) (Yuan et al., 2021).

FRAME *(Framework for the Rational Analysis for Mobile Education) Model:* This model was initially developed to understand the process of mobile devices as learning tools for distance learning, with the goal of guiding the development of mobile learning materials and the specification of teaching and learning with mobile devices. The three key ingredients of the FRAME model are: device usability, learner and social aspects (Koole & Ally, 2006).

Literature highlights that the digital era is upon us. The fourth industrial revolution (4IR) brings with it new ways of thinking, new ways of being and new ways of doing. There is a call to conceive the 4IR as a digital learning environment where learners are the central focus in that environment through the "technology-enabled learner-centered" approach (Oke & Fernandes, 2020, p. 22). In contrast, as the world moves out of the shadows of the COVID-19 pandemic, a blended learning model is most likely to emerge and last into the future of education. Thus, technological trends are most likely to shape the face of future education.

This implies that with the demand for increased application of technology (mobile learning) to support teaching and learning, there is also a need to develop frameworks that enable the effective integration of technological pedagogy and promotes evidence-based meaningful learning (Baran, 2014; Bonfiglio-Pavisich, 2018). Therefore, in the context of this research, it was the wish of the researcher to develop a framework of Mobile-Mediated Action Learning Framework (M-MALF) which aims to enhance pre-service teachers' engagement that is mediated through mobile devices to transform teaching and learning practices through technology. I would argue that preparing pre-service teachers with skills and capacities as future educational agents suggests a greater emphasis on transforming teachers' pedagogical habitus to employ mobile learning as part of their training and aligns with authentic contexts as that employed in this study.

3.3 Teaching and Learning Mediated by ETs: Demands of a 21st Century Classroom

There are international and national imperatives on how to incorporate emerging technologies into twenty-first century teaching and learning skills (Lautenbach, 2014; Ng'ambi, 2013). Engaging learners with technology-mediated learning activities (i.e., Lautenbach, 2014), redesigning initial teachers' education practices (Pedro et al., 2019), designing for open and social learning (Couros & Hildebrandt, 2016), innovation in teaching, learning, and assessment (Ferguson et al., 2019), are some of the proposed scenarios by educators on how to develop 21st century skills through technology mediation tools. Based on this concept, teachers become mediators to facilitate new knowledge-based learning while technology becomes a mediation tool of knowledge creation and skills development (Altınay-Gazi & Altınay-Aksal, 2017).

Mediation can be defined as people's interactions with others as mediated by tools including symbols and rules (Russell, 2002). While tools (*in the context of this study Padlet)* can be defined as the artefacts that mediate subjects' (*for this study students*) interaction with the object (*for this study mobile-mediated learning experiences*) to achieve some predetermined outcomes (*pre-service teachers mobile learning framework*) (Ng'ambi et al., 2015, p. 228). It therefore follows that technology can be used as a mediator or facilitator for teaching and learning which is classified as the interactions among the learner, the technologies, and the environment (Grant, 2019). Elaborating on this analogy further, a pre-service teacher may use Padlet, a mobile phone connected to mobile network as well as mobile data to discuss and complete his/her teaching methods assignment/tasks. In this instance, learning is mediated through mobile devices (Smartphones), mobile network connection (Mobile Telecommunication Company) and mobile social learning tool (Padlet) as well as data bundles or WIFI among the pre-service teachers.

Russell (2002) associates electronic tools as a new way of mediating the division of labour in such a way that students can immediately share new materials with their teachers and other students through links to websites. Of course, new electronic interaction tools have the potential to enhance collaboration among the students teachers through mediation. In addition to improving teaching and learning practices through technology, this implies that for a modern educator to deliver quality education, there is a need to be acquainted with innovative pedagogies that can influence their

teaching practices. In the seventh series of annual reports on innovations in teaching, learning, and assessment (which is compiled by a group of academics from the Institute of Educational Technology at the Open University, UK, and Norway's Centre for Science of Learning & Technology (SLATE)), introduces ten pedagogies that are either already being practiced or offer opportunities for effective teaching and learning in the modern technology-enabled world (Ferguson et al., 2019). These innovative pedagogies were conceptualised by Ferguson et al., (2019) as follows:

Playful Learning: Teachers need to be aware of the various forms of play and the benefits it has for learning. Playfulness in learning can happen in many forms such as pretend play, mobile play (for this study: mobile learning), digital games, and developing playful values.

Learning with Robots: Robots can assist teachers by responding quickly to numerous queries from learners or helping them with assessment. i.e., "the SoftBank NAO robots can speak and understand 20 languages, using cameras to recognize people and objects" (Ferguson et al., 2019, p. 12).

Decolonising learning: Teachers can adopt a pedagogy that can support a variety of approaches to digital decolonisation. i.e., the creation of various games that represent their cultural heritage and serve the needs of their local communities (also see OERiGA project http://etilab.uct.ac.za/oeriga/)

Drone-Based Learning: Drones are small vehicles in the form of aircraft or waterborne craft that are controlled remotely. They can be used by teachers to enable or enrich the exploration of various physical spaces. That is, in an agriculture class, learners can use drones to monitor their garden and be able to detect changes in their plants, etc.

Learning through Wonders: Teachers can include wonders in learning activities through magic shows, objective lessons, wonder walls, a sparkling stone, an outdoor hunt, etc. that conjure a sense of wonder. That is, a teacher goes with his/her learners to look for different species of plants in the park. Learners can be advised to record and question the things they see that make them wonder (using their mobile phones).

Action Learning: Action learning combines learning-by-doing with reflective learning and collaborative learning to find actionable solutions that can be applied in the real world. That is, a teacher can use a Padlet app and invite students to work on a real-life problem while supporting each other through posts and commenting on each other's posts (see Chapter Five).

Virtual Studios: Virtual studios are all about the online exchange of ideas, rapid feedback from the tutors and peers, checks on progress against learning outcomes, and collaboration. The aim is to support learning through inquiry and dialogue. That is, the teacher can ask students to design a T-shirt, and they can be guided by seeing the work of their peers (this practice can also be done by students using their mobile smartphones).

Place-Based Learning: Place-based learning provides new learning opportunities within a local community, location and uses the natural environment to inspire the students. It can be used to add virtual information to physical settings and offers an emerging set of tools that can be used to support learning outside the classroom. i.e., students sharing images, locations, and joint approaches to setting up tasks that make local collaboration easier (using their mobile smartphones).

Making Thinking Visible: various tools allow students, alone or together, to demonstrate their understanding of phenomena and ideas by visualising them in different ways. This enables them to develop understanding by presenting and evaluating different types of work. That is, students use different software to create models, videos or texts that bring together audios, images, and videos (using their mobile smartphones).

Roots of Empathy: Roots of Empathy is "a classroom program that is designed to teach children empathy" (Ferguson et al., 2019, p. 5). This is to promote emotional awareness, which may result in a more caring environment in classrooms and schools. That is, children can be tasked with identifying the emotions of babies and then describing and explaining them.

The main reasons for calling for new pedagogies and skills referred to as 21st century skills are the demand being placed on educational institutions by the industry and the government (Shouman & Momdjian, 2019). Scholars have provided empirical evidence

to highlight the affordance of mobile learning and pedagogical opportunities that mobile devices could offer (viz., Crompton & Burke, 2020; Kearney & Maher, 2019; Ophoff, 2013) Furthermore, in recent years, students now have access to mobile devices such as laptops, tablets and smartphones, which provides them with more opportunities for e-learning rather than having to access online materials in a computer lab or at home (Crompton, 2017; Crompton & Burke, 2020). Could mobile learning, then, be a game changer in teaching and learning? Can mobile learning transform pedagogy?

3.4 Mobile Learning transforming pedagogy: *where to next?*

Mobile learning (MLEARN or M-learning) is a concept that was introduced in 2002, which has some familiar connotations and is concerned with learner mobility (Luckin et al., 2005) when learning with mobile technologies. Mobile learning enables learners to engage in educational activities without the constraints of having to do so in a tightly delimited physical location or environment (Luckin et al., 2005). To keep up with developments in this field, educators, researchers, trainers and practitioners are continuing to explore how mobile devices may be used for teaching and learning, while bearing in mind the various educational, personal, social and cost implications involved (Cai, 2021; Herrington et al., 2009; Kearney & Maher, 2019; Luckin et al., 2005; Mohamed Osman & Johannes, 2010; Montrieux et al., 2014; Ophoff, 2013; Palalas & Wark, 2020). Educators are keen to incorporate the use of such mobile devices in teaching and learning activities. As with the affordance of mobile devices, “scholars have postulated that learning can be transformed” (Crompton & Burke, 2020, p. 1).

According to Lefoe et al. (2009), there are numerous opportunities for pre-service teachers to engage in new pedagogies to influence changed practices from early childhood through secondary and tertiary education using mobile technologies. This supports the argument of this study that engaging future teachers with new pedagogies or mobile learning during their training will enable them to meet the needs of their future learners in a digitally connected world.

3.4.1 What is mobile learning?

The term “M-Learning or “Mobile Learning", has different meanings for different communities, that refer to a subset of E-Learning, educational technology and distance education, that focuses on learning across contexts and learning with mobile devices” (Mehdipour & Zerehkafi, 2013, p. 93). The concept of mobile learning emerged as a result of the growing interest of using mobile devices such as smartphones, tablets, e-

books, portable audio players, mp3 players, game consoles, notebooks, laptops and personal digital assistants (PDAs) [*as they are becoming more and more ubiquitous, sophisticated; different operating systems such as IOS & Android; smarter; continually upgrading; portability; numerous functions, i.e., quick access to data, camera functionality, media presentation, gaming, data storage; multiple mobile applications etc.*] in the modern teaching and learning (see Cai, 2021; Tezer & Beyoğlu, 2018). As these benefits of mobile learning become clearer, researchers need to understand the factors that determine the future use (adoption) of mobile learning (Mac Callum & Jeffrey, 2013). The popularity of these devices is therefore a consequent of their ability to function at multiple levels (Mohamed Osman & Johannes, 2010), allow access to knowledge anytime and anywhere (Uther, 2019), wireless and portability of the devices (Crompton, 2017; Mohamed Osman & Johannes, 2010) and easy mobile network access (Tezer & Beyoğlu, 2018). In general, "mobile learning or m-learning can be viewed as any form of learning that happens when mediated through a mobile device, and a form of learning that has established the legitimacy of nomadic learners" (Cronje, 2016, p.132).

Mobile learning is not centred on the device but what learning can be achieved through the use of the mobile device (Crompton & Burke, 2020). Mobile learning (M-learning) is described in various ways by different researchers, but these descriptions all consider the nexus between working with mobile devices and the occurrence of learning: the process of learning mediated by a mobile device (Kearney et al., 2012).

According to Tezer and Beyoglu (2018, p. 876), definitions of m-learning are divided into four sub-titles, namely; (a) Technology-based focuses on learning activities executed by various mobile devices, (b) E-learning views mobile learning as an extension of e-learning activities and focusses on e-learning activities with the support of mobile devices, (c) Formal learning support - accentuates that mobile learning should be applied to support and enrich ordinary lessons and courses by its multiple contributions, (d) Learner based - emphasises that learning methods should be personalised towards the interests, demands and needs of individuals without restrictions on time and place. This illustrates that mobile learning is a broad concept with multiple perspectives.

A common definition of mobile learning is “learning across multiple contexts, through social and content interactions, using personal electronic devices” (Crompton, 2017, p. 208), thereby facilitating and enhancing the learning process via mobile devices anytime and anywhere (Baydas & Yilmaz, 2018), a kind of learning method which uses mobile devices (Tezer & Beyoğlu, 2018). While Lefoe and Olney (2007, p. 2) define M-learning as “personal access to mobile technologies providing learners with opportunities to be flexible in the way they collect, store, and share information to support their learning.” Another contrasting view of mobile learning is described as any sort of learning that happens when the learner is not at a fixed, predetermined location or learning that happens when the learner takes advantage of learning opportunities offered by mobile technologies (Vavoula et al., 2004).

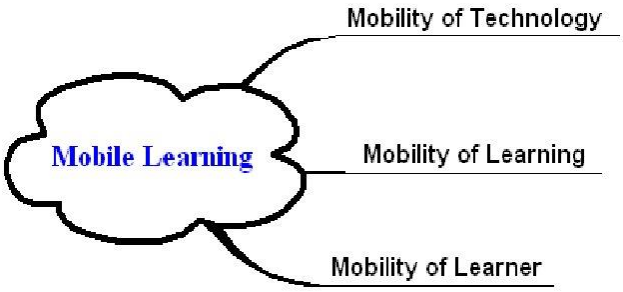
According to Li and Wang (2018), the definition of M-learning contains four elements/ strands: “focusing on technology; focusing on changes in learning and teaching brought about by improved mobility; blended types focusing on both technology and changes in teaching and learning; and a purely behavioral description” (p. 556).

Mohamed Osman and Johannes (2010) argue that the portability and mobility of mobile devices have had strong implications for the meaning of mobile learning that has been defined in existing literature. They define the significance of mobile learning in three ways: "mobility of technology; mobility of learner; and mobility of learning, particularly in the high education context" (p. 17). All these characteristics of mobility denote that mobile learning is learning that can occur anywhere and anytime. Figure 3.2 below is a depiction of the three divisions of mobile devices that can deliver a higher level of educational instruction (Mohamed Osman & Johannes, 2010).

Therefore, m-learning can be identified in this study as the process of learning mediated by mobile digital devices and the internet (Kearney & Maher, 2019) that can occur inside or outside the classroom, meaning anytime, anywhere. In contrast, mobile learning can also be described as a teaching and learning approach that employs mobile devices to sustain high levels of student engagement or collaboration with rich connections to other students (pre-service teachers) and resources across different subject contexts (Luckin et al., 2005).

Figure 3.2

The three concept of Mobile Learning



Note: This figure below depicts the three divisions of mobile devices that can deliver a higher level of educational instruction. From "Defining Mobile Learning in the Higher Education Landscape," by M.E. Mohamed Osman and C.C Johannes, 2010, *Educational technology & society, 13(3), p.17*. Copyright 2010 by Educational technology and society

My perception is that training pre-service teachers in higher education to embrace the benefits of using mobile devices in pedagogies is through mediation, connectivity and mobility.

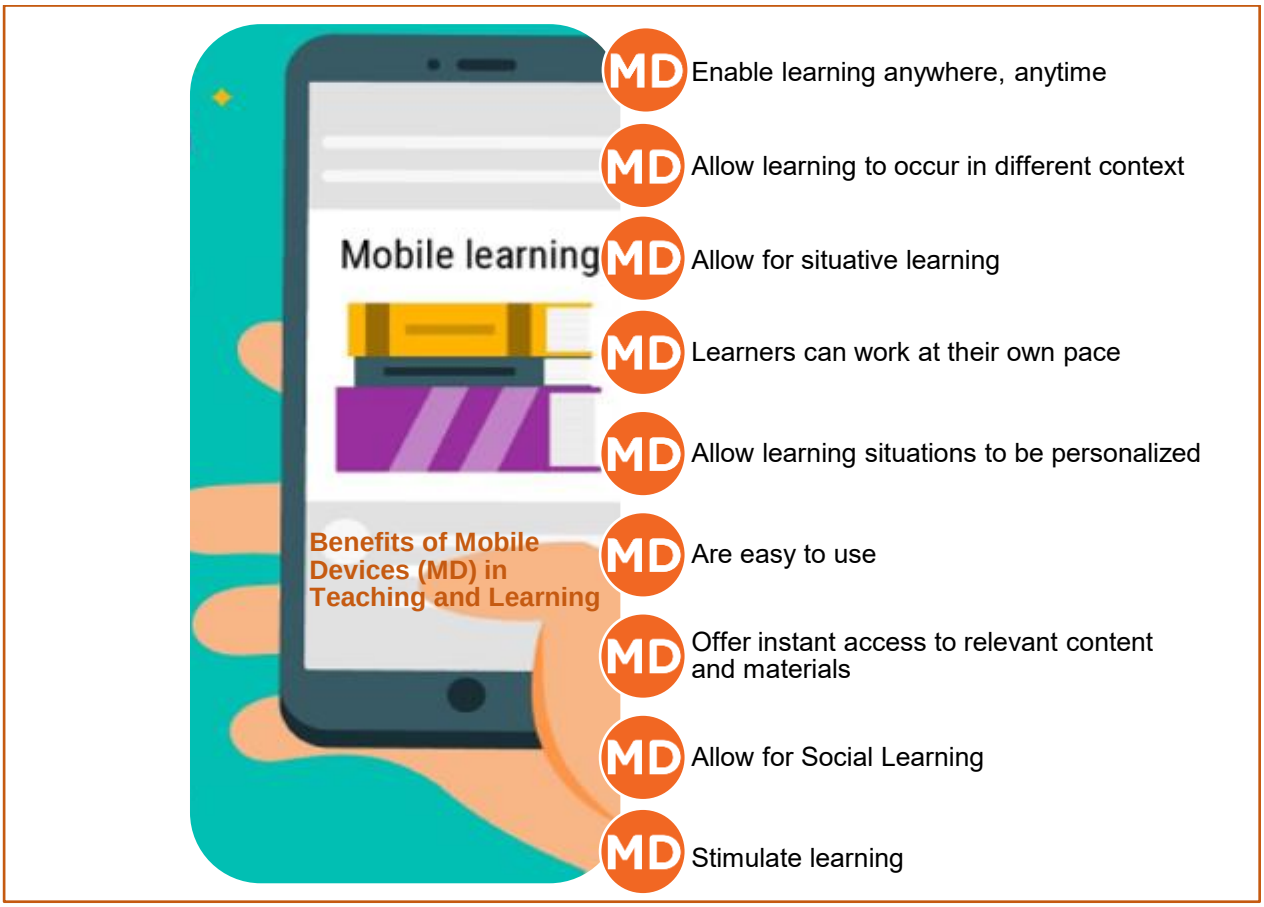
3.4.2 Pedagogical Transformation through Mobile Devices

Following the concept of mobility of learning by means of mobile devices (see Cronje, 2016), learning that can occur anywhere and anytime (Rikala, 2015a), "mobile technologies can enable the development of innovative pedagogical practices such as student-centred pedagogies as well as several communication and problem-solving skills along with critical thinking skills" (Zidoun et al., 2019, p. 157). In contrast, new m-learning constructions embrace the mobility of the context of interaction mediated by technologies (Rambe & Bere, 2013). Yet, using and adopting mobile devices as tools for learning is still in a compelling state of experimentation and design (Dikkers, 2013), as it is not clear that they are being used in pedagogically appropriate ways (Herrington et al., 2009). The adoption of mobile technology will be primarily determined by students' belief that mobile technology meets their specific demands (Mac Callum & Jeffrey, 2013). Henceforth, researchers and practitioners have proposed different theories, models, and paradigms of teaching and learning structured and supported by mobile device practice in an educational context (Rikala, 2015a).

It has been suggested that mobile technologies can be integrated in various ways in and outside the classroom to enhance and extend learning and therefore can promote innovative teaching practices. Basically, mobile learning can be seen as a method for enhancing and mobilizing teaching and learning (Uther, 2019). What is noteworthy is that mobile devices have the capacity to link to the Internet and deliver content and instruction that can enable students to learn at anytime and anywhere. Mobile learning offers various benefits is teaching and learning. I illustrate these benefits of mobile devices (MD) in teaching and learning in figure 3.3.

Figure 3.3

Benefits of Mobile Devices in Teaching and Learning



Note: This figure depicts benefits of mobile devices in teaching and learning as outlined in Rikala, 2015a. Own work

Rikala (2015a) outlines some benefits of the mobile learning or the use of mobile devices in teaching and learning as follows (see Figure 3.3 above) :

- It can support learning anywhere and anytime
- Learning can occur in different contexts inside and outside the classroom

- The learning situations can be either formal planned lessons or informal unplanned and spontaneous learning experiences
- The learning experiences are motivating for learners as learners can work at their own pace
- Learning situations are personalised and consequently also interesting and meaningful to learners
- Mobile devices are easy to use, intuitive, and portable and enable learners to concentrate on the task in a specific context, not the device itself
- A mobile device enables learning on the move and in different contexts
- Learners can exchange information and acquire knowledge with rich connections to other people and resources mediated by a mobile device
- Different kinds of interactions can stimulate learning

According to the aforementioned, the introduction of mobile devices presents a significant opportunity in terms of interaction between students and teachers or between students and other students, as well as pedagogical transformation. For example, a research conducted by Herrington et al. (2009) which looked at how to use mobile technologies to develop new ways of teaching and learning used the games-centred approach as one of the approaches. A task was given to the second- and third-year preservice teachers using iPods to enhance their understanding of questioning methods, the development of dialogue, and the pedagogical use of game-centred approaches in physical educational lessons. From the pedagogical perspective, the game-centred approach was inclusive of the notion of enhancing student learning, enhancing collaboration, and student engagement, an approach that enables the use of mobile devices to support teaching and learning more effectively.

On the contrary, researchers also identify some key challenges and barriers that may hinder the success of mobile learning in both technical, social, and educational aspects. Mehdipour and Zerehkafi (2013, p. 97) delineated some of the issues that have evolved from different studies and reviews that are considered to be challenges that may hinder the integration of mobile devices in teaching and learning. They are outlined as follows:

Technical challenges for M-Learning (Mobile Devices) include:

- Connectivity and battery life
- Screen size and key size (Maniar and et. Al. 2008)

- Meeting the required bandwidth for nonstop/fast streaming
- Number of file/asset formats supported by a specific device
- Content security or copyright issues from the authoring group
- Multiple standards, multiple screen sizes, and multiple operating systems
- Reworking existing E-Learning materials for mobile platforms
- Limited memory (Elias, 2011)
- Risk of sudden obsolescence (Crescente & Lee, 2011)

Social and educational challenges for M-Learning include:

- Accessibility and cost barriers for end users: Digital divide
- How to assess learning outside the classroom
- How to support learning across many contexts
- Contents security or pirating issues
- Frequent changes in device models/technologies/functionality, etc.
- Developing an appropriate theory of learning for the mobile age
- Conceptual differences between E-Learning and M-Learning
- Design of technology to support a lifetime of learning (Sharples, 2000; Moore, 2009)
- Tracking of results and proper use of this information
- No restriction on the learning timetable
- Personal and private information and content
- No demographic boundary
- Disruption of students' personal and academic lives (Masters & Ng'ambi, 2007)
- Access to and use of the technology in developing countries (Masters, 2007)
- Risk of distraction (Crescente & Lee, 2011).

As per the aforementioned, m-learning is certainly not merely the conjunction of mobile and learning (Mehdipour & Zerehkafi, 2013). Within these special aspects, there are a range of theories, models, frameworks, and approaches to teaching and learning that cover the breadth of how mobile devices can be effectively used to structure and support mobile learning practices in an educational context. To aid readers' understanding, I summarised some theories of mobile learning, the learning process for each theory, and provided examples of how it can be incorporated into mobile learning practices. Table 3.1 depicts brief descriptions and hypothetical examples of mobile learning practices as modified and adapted by Rikala (2015a).

Table 3.1

Summary of Theory-Based Examples of Mobile Learning Practices

Theory and paradigms for Mobile Learning	Description	View of the Learning Process	Examples with Mobile Learning Practices
Behaviourist	Draws from the early behaviorists' work, such as Skinner's work on operant conditioning and behaviorism in the 1930s, focuses on a *change in behavior* that can be facilitated through the reinforcement of a specific stimulus, response and a consequence	Change in behavior and observable actions facilitated through the reinforcement of a specific stimulus and response	*Drill and feedback activities:* e.g., memorization of vocabulary or rehearsing mathematical skills etc.
Cognitivist	Piaget and Bandura (1936) work stressed that knowledge acquisition is described as a *mental activity* that entails internal coding and structuring by the learner	Learning results from organising and processing information effectively	*Cognitive Performance support:* For example, provide students with an information awareness reminder mechanism through mobile devices to support their learning in class via Padlet wall.
Constructivist	Emerged during the 1960s and 1970s. It can be separated into cognitive constructivist (via Piaget's theory) and social constructivist (via Vygotsky's theory), focuses on the *learner-centred paradigm* which places learners in an open-ended learning environment in which they build their own meaning from knowledge and content	Learners actively construct new ideas or concepts based on both their previous and current knowledge (past meet present- a theory used for this study)	Approaches such as: *Experiential learning:* For example, students observed and recorded different types of packaging, collected data on plastic bags, and interviewed people in a local supermarket about their perspectives on the environment using their mobile devices and post their findings on a Padlet wall. *Participatory simulations:* For example, students explore the behaviour of the virus and test their own experimental hypotheses using mobile devices and post results on a Padlet wall *Discovery learning:* For example, students used a customised eBook Maker mobile application to individually explore the scientific phenomena from their daily life, record their investigations (e.g., by taking pictures, recording audio,

			writing notes), and create mobile documents. *Collaborative learning:* For example, students are assigned a task to work as an individual and later assigned to a small group to share and discuss their answers using their mobile devices. *Situated learning:* For example, Students conduct research together, integrate theory and practice, and apply knowledge and skills to develop a solution to a defined problem through the mobile devices using Padlet platform.
Humanistic	Emerged in the 1960s, originating primarily in the work of Abraham Maslow and Carl Rogers, and focuses on *basic human needs* which prioritise the learner's self-direction, inner motivation, and self-reflection	A personal act to fulfil potential flexibility in managing own learning space	*Self-directed learning:* For example, teachers can send assignments or learning materials to the students' mobile devices via Padlet wall and they can access them anywhere and anytime
Connectivism	A learning theory for the Digital age, introduced by George Siemens in 2004. It aims to provide insights into the learning skills and tasks needed in a *digital era using mobile devices*	Connecting, navigating and filtering specialised nodes or information sources	*Social networking and media creation:* For example, students can use their mobile phones to capture pictures, edit them, and upload them to a Padlet. They can also collaborate via the Padlet

Note: Adapted from "designing a mobile learning framework for a formal educational context", J. Rikala, 2015a.

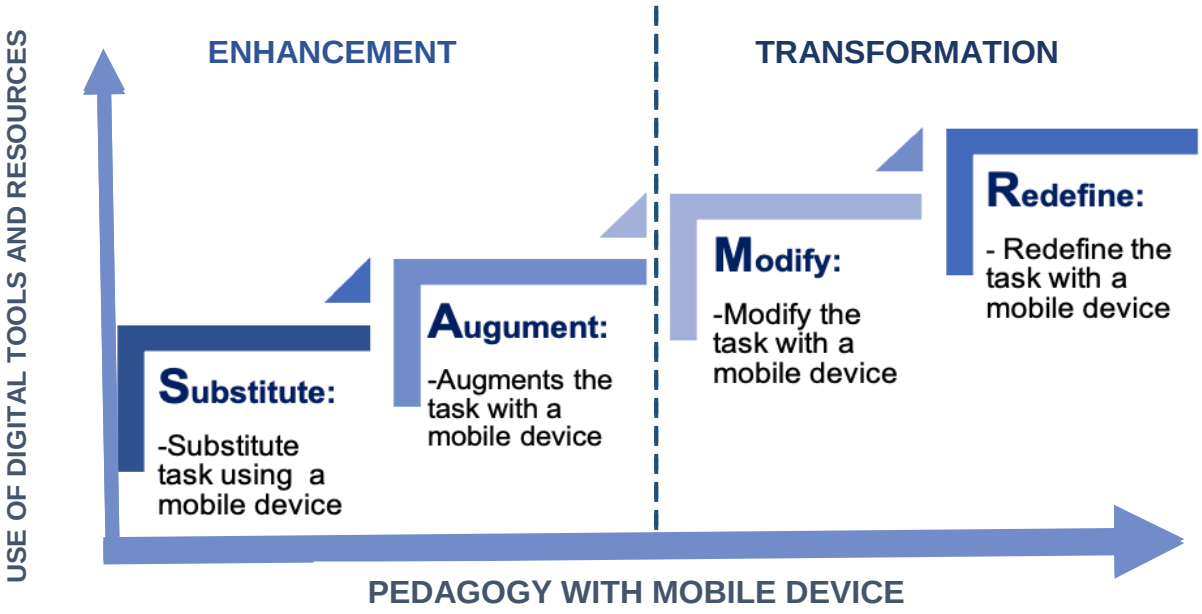
The degree of pedagogical transformation of these (see Table 3.1) approaches is considered using an observational taxonomy developed by Dr Ruben Puentedura for classifying the role of technology use with learning activities from the Substitution, Augmentation, Modification, and Redefinition (SAMR) model (Hamilton et al., 2016; Romrell et al., 2014).

The second level is *augmentation*. Here technology is exchanged and the function of the task or tool positively changes teaching and learning in some way (Hamilton et al., 2016) and enhancement occurs. Meanwhile, the task is largely unchanged (SA, 2017). For instance, pre-service teachers use word processing tools such as spell check,

grammar check, and auto correct to augment the writing process using their mobile devices.

Figure 3.4

How SAMR Model can be instilled in a mobile-mediated learning practice



Note: This figure displays Puentedura's SAMR levels and how they can be used to evaluate whether mobile devices can achieve the desired level of learning and properly equip students with 21st century skills. Own work.

The third level is *modification*. At this level, technology integration requires significant changes to the task itself. Learning is not only enhanced at this stage but also transformed (Shouman & Momdjian, 2019). For instance, pre-service teachers complete a task by working together (collaboration) to create, edit, read, and use learning artefacts accessed via their mobile devices. This is easier when there is a need to include more learner feedback on writing and using their mobile phones.

Finally, at the top of the framework, is *Redefinition*. At this level, technology is being used for learning in a way that could not happen without technology or offline. The potential for creativity and innovation is unleashed (Shouman & Momdjian, 2019) and learning is transformed. For example, pre-service teachers develop an online video lesson and post it to their YouTube channel for their learners to have access to it.

One of the key questions for the use of mobile devices in learning is the "how". The SAMR model has given us guidance on how technology can be used to enhance and

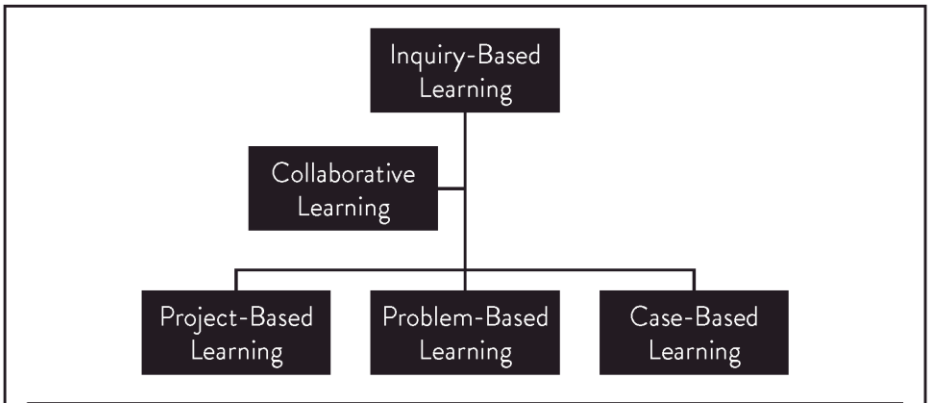
transform learning. The foregoing pedagogical innovative approaches proposed by a group of academics have shown that learning with technology needs more than making learning activities digital; it is also about creating contexts for authentic learning that use emerging technologies in integrated and meaningful ways to enhance the construction of knowledge, communication, and sharing of ideas (Yelland, 2006). To advance this, policymakers should consider introducing technical and pedagogical support in order to facilitate both teachers' and students' understanding of the full potential of this kind of emerging technology in education (Montrieux et al., 2015). In order to expand the notion of a "how" question in mobile learning for this study, the following section articulates the context of authentic learning and illustrates the ways in which mediated authentic mobile learning is enabled (Ng'ambi et al., 2016).

3.4.3 Authenticity in mobile learning

For the purpose of this study, authenticity in mobile learning environments is defined as "an instructional approach which allows learners to discuss, explore and collaborate to construct new knowledge and create new real artifacts in real-world settings and tasks" (Chang et al., 2018, p. 5) using a mobile device. Authentic learning is best described as a pedagogical model as it is not a learning theory in its own right. Rather, it is an approach that can be adopted by educators to design effective and engaging learning environments for their students to enable them to learn (Van der Merwe, 2015).

Figure 3.5

Outline of authentic learning



Note: This figure illustrates some of the learning activities that are included in authentic learning practices. From "Authentic Learning: Real-World Experiences That Build 21st-Century Skills," by T. Stanley, 2018, *Taylor & Francis Group*. Copyright 2018 by Taylor & Francis Group.

In addition, authentic learning appears as a pedagogical approach because it situates knowledge in realistic contexts and challenges students with realistic tasks and activities, requiring them to think and problem-solve as they might in a real situation (Van der Merwe, 2015). Its foundation is based on the theory of situated learning or situated cognition (Miller, 2012). Situated learning was developed by the researchers Brown, Collins, and Duguid and it is defined as "the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life" (Collins,1988, p. 2 cited in Miller, 2012, p. 13) or solving real-world problems (Chang et al., 2018). Lombardi (2007) describes authentic learning as learning that focuses on real-world, complex problems and their solutions. Hence, a successful authentic environment has to create enough (and the right) situated opportunities to ensure that adaptation that arises for a specific learner has both a high structural as well as a semantic fit (Imran, 2006).

As an authentic learning environment is similar to some real world applications such as role-playing, learning by doing, project-based learning, and problem-based learning (Chang et al., 2018), inquiry-based learning, collaborative learning, case-based learning, etc., are some of the learning activities that are included in authentic learning activities (Stanley, 2018) (see Figure 3.5).

As Herrington and Oliver (2000) points out:

> such learning environments typically provide authentic contexts and activities, access to expert performances, and support multiple roles and perspectives. In addition, such environments also support collaborative construction of knowledge and promote reflection and articulation. Finally, such environments may include coaching and scaffolding by the teacher and provide for authentic assessment of learning within tasks (as cited by Imran, 2006, p. 198).

Authentic learning offers some important benefits, which are: (a) boosts motivation; (b) better learning opportunities; (c) preparation for a better future; (d) makes a complex concept easier to understand; and (e) blends theories with learning (Chang et al., 2018, p. 5). However, Chang et al. (2018) argue that using technology to support authentic learning is still a big challenge for educators. Authentic learning is appealing as a pedagogical approach because it situates knowledge in realistic contexts and challenges students with real-world tasks requiring them to think and problem-solve as they might in a real situation (Van der Merwe, 2015).

Therefore, the current study attempted to review different aspects of authentic learning and the applications of mobile devices to make authentic mobile learning more effective. Herrington and Oliver (2000) have distilled the essence of the authentic learning experience down to nine design elements, providing educators and practitioners with a useful checklist that can be adapted to any subject matter domain. Ideally, an authentic learning environment requires students to engage in realistic and complex tasks using real-world resources and tools encompassing the entire curriculum, which also provides students with the opportunity to learn with the intention of thinking and acting like professionals. For example, students act as professional teachers or educators (Herrington et al., 2014). These authentic design elements of situated learning and how it can be manifested in a mobile learning environment are summarised and illustrated in table 3.2.

Table 3.2

Manifestation of authentic design elements of a situated learning in the mobile learning environment

Authentic Design Element	Description and guideline for implementation
Provide authentic contexts that reflect the way the knowledge will be used in real life	- Set a physical environment reflecting the way knowledge will be used in real-life - Avoid simplify learning context - A non-linear design
Provide authentic activities	- Set tasks that have real-world relevance and well-defined - Set tasks that can be integrated across subject areas - Set a simple complex task - Provide an opportunity to detect relevant and irrelevant information
Provide access to expert performances and the modelling of processes	- Provide access to expert thinking and modelling processes - Provide access to learners in various levels of expertise - Provide the opportunity to share stories - Provide access to the social periphery
Provide multiple roles and perspectives	- Enable different perspectives on the topic from various points of views - Provide the opportunity to express different points of views - Allow the opportunity to criss-cross the learning environment
Support the collaborative	- Develop tasks that are completed in pairs or groups rather than individually

construction of knowledge	- Set appropriate incentive structures for whole-group achievement
Promote reflection to enable abstractions to be formed	- Provide students with the opportunity to return to the experience, attend to feelings and re-evaluate the experience - Provide the opportunity for students to compare themselves with other learners or expert - Provide collaborative grouping of students
Promote articulation to enable tacit knowledge to be made explicit	- Provide a complex task incorporating inherent opportunities to articulate - Provide groups to enable social then individual understanding - Provide public presentation of argument to enable the defence of learning
Provide coaching and scaffolding by the teacher at critical times	- Enable a complex, open-ended learning environment - Provide guidelines for the use of the programme in a variety of contexts - Provide collaborative learning where teachers can assist with scaffolding and available for coaching
Provide for authentic assessment of learning within the tasks	- Provide the opportunity for students to craft polished performances or products - Provide complex, ill-structured challenges - Provide multiple indicators of learning - Set assessments which are valid and reliable with appropriate criteria

Note: Adapted from “an Instructional Design Framework for Authentic Learning Environments” by J. Herrington, and R. Oliver, 2000. *Educational technology research and development*, 48(3), 23-48. Copyright 2000 by Educational technology research and development

3.1 Related M-learning Research

Mobile learning research encompasses a wide range of studies focusing on the integration of mobile devices and technologies in educational settings (Crompton & Burke, 2020). It's important to note that the specific pedagogical approaches, mobile learning mediated learning practices, tools used, and data collection processes can vary across different research studies. The choice of these elements depends on the research objectives, the context of the study, and the research questions being investigated. Researchers often employ a combination of qualitative and quantitative methods to gather comprehensive data and gain insights into the impact of mobile learning on teaching and learning processes.

Table 3.3

Related m-Learning research

Author(s) & Year	Type of Study	Pedagogical Approach/Theory	Mobile-meditated learning practice	Tool/s and data collection instruments
Crompton Helen (2017)	Using Mobile Learning to Support Students' Understanding in Geometry: A Design-Based Research Study	Local instructional theory of learning	Students from two fourth grade classes used iPads in dyads and groups to learn angle	*Tool/*s: iPads and Sketchpad Explorer App *Instruments:* observations, video, research journals, and artefact
Rambe, Patient & Bere Aaron (2013)	Using mobile instant messaging to leverage learner participation and transform pedagogy at a South African University of Technology	Framework for the Rational Analysis of Mobile Education (FRAME)	Third-year information technology (IT) students undertaking an IT module at the CUT in South Africa used MIM and WhatsApp for peer-based engagement	*Tools:* Mobile Instant Messaging (MIM) and WhatsApp *Instruments:* Interviews Questionnaires IT educator diarized reflection
Rowe Michael, Bozalek Vivienne & Frantz Jose (2013)	Using Google Drive to facilitate a blended approach to authentic learning	Social constructivist and Situated theories of learning Case-based learning approach	A small group of six students from a physiotherapy department. Students used clinical cases to create their own content, guided by a team of facilitators on google drive	*Tools:* Google Drive *Instruments:* Focus group Google Drive posts
Ng'ambi Dick & Lombe Annette (2012)	Using Podcasting to Facilitate Student Learning: A Constructivist Perspective	Constructivism theory of learning Interpretive approach	Two cohorts of postgraduate students enrolled on a blended course and podcasts were integrated in their learning design	*Tools:* Vula as a Podcast server, blogs, wikis, and maps *Instrument:* Interviews, logs from the podcast server
Hoban Garry (2009)	Using mobile phone cameras to capture images for slowmations: Student - generated science	Constructionism theory of learning	Twenty-four preservice teachers were enrolled in a 13-week science method course in the third year of a four-year Bachelor of Education Degree at a University in Australia. They were	*Tools:* Mobile phones cameras *Instruments:* Interviews Observations

	animations		using their mobile phones cameras to take images and create slowmations about a science concept with their classes of primary school children	
Hrepic, Zdeslav (2007)	Using Tablet PCs to Explore the Interactive Learning Environment: Engage Students in Learning	Social constructivism, Situated cognition, and Distributed intelligence, Interactive learning	Ten students from an introductory physics class explored DyKnow features, the interactive software designed for pen-enabled learning environment. Students used features such as note-taking, content sharing, and private notes	*Tools:* Tablets and DyKnow App *Instruments:* Survey questionnaire

3.2 Chapter Summary

This chapter described in detail how emerging technologies and mobile learning unfolded and their impact on the 21st century classroom. The chapter detailed how the concept of mobile learning emerged because of the growing interest in using mobile devices in teaching and learning. The following chapter (four) presents the literature review from the Namibian context as part of Phase One of DBR.

CHAPTER 4: LITERATURE REVIEW
(DBR: PHASE ONE)

4.1 Chapter Overview

This chapter presents the literature review to explore emerging technologies in education, specifically from a Namibian perspective which serves as the context for this study. By delving into the literature, I aim to gain a comprehensive understanding of the current landscape of educational technologies in Namibia and how they align with the purpose of this study. This literature review sets the foundation for the subsequent phases of the research and provides valuable insights into the unique challenges, opportunities, and trends pertaining to technology integration in Namibian education.

4.2 Namibian Educational Reforms - An Overview

Before Namibia's independence in 1990, the country's education system was designed to ensure a continued apartheid system as opposed to providing the necessary human resource base towards the promotion of equitable social and economic development (Katjavivi, 2016). The education system was fragmented along racial and ethnic lines, in what was termed "Bantu Education," which was also enforced in black communities in South Africa. There were vast disparities in both the allocation of resources and the quality of education offered during the colonial era. This had a "great impact on the quality of education in Namibia" (Katjavivi, 2016, p. 3).

Since independence in 1990, the Namibian education system has undergone reforms because of the government’s commitment to provide equitable quality education for all and rectify the past apartheid system. However, although the government has implemented a range of educational reform initiatives, it has persistently failed to provide equitable and quality education for all (UNESCO, 2013). Inequity amongst the number of people continues to persist, especially for the poorest and marginalised communities. Thus, the Namibian education reform is deemed to be unsuccessful in achieving the Education for All (EFA) goals, which are based on access, equity, quality, and democracy (Hamunyela, 2016; Katjavivi, 2016; NIED, 2019; UNESCO, 2013).

According to UNESCO (2013), Namibia has invested roughly 22% of its annual budget on education to improve the quality of teaching and learning. However, results in this respect have been disappointing as learners are not achieving high levels of performance compared to neighbouring countries, and a skills gap persists, which

constrains growth. EMIS Education Statistics (2010-2018) confirms a continual poor performance among learners across grades. For example, in Grade 12, only 30–35% of learners qualify for further study at higher learning institutions. In addition, about 3,500 unqualified and underqualified teachers are still teaching in schools (Steenkamp, 2019). Furthermore, some schools that do not have physical educational facilities and unequal distribution of resources, especially for schools in remote areas, persists (EMIS, 2010-2018).

Coupled with the increasing volume of educational reforms in Namibia, efforts have also been made to keep up with the global demand for integrating technology into pedagogy. Several national strategic documents and policies have recognised the need to develop emerging technologies within the education sector in Namibia. Some of these documents are as follows:

- ***Vision 2030***
- "Integrating ICT education and training into education and training system"

- ***NDP2***
- "Coordinating with the Ministry of Basic Education, Culture and Sport to introduce Computer Literacy as a compulsory subject in schools"

- ***Strategic Plan for The Ministry of Basic Education (2001 – 2006)***
  "Manage and use modern information technology to communicate and share information"

- ***National ICT Policy***
  "It is critical to emphasize training of teachers who will teach ICT-related subjects*"*

- ***ICT Strategy for Ministry of Higher Education (Draft)***
- "To increase the nations ICT skills"

- ***Public Service Information Technology Policy***
  "Introduce Information Technology at junior secondary school level"

- ***Information for Self-Reliance and Development – A Policy Framework for Libraries and Allied Information Agencies for Namibia***
  "IT literacy will be widely promoted among the population" (MOE, 2005, p. 3).

The Namibian revised basic education curriculum incepted in 2014 also envisages the incorporation of a variety of innovative technologies into the classroom, including, among others, learners being able to subscribe to Internet groups, forums, and blogs (NIED, 2015). During the Namibian National Conference on Education held from August 2 - 5 2022 under the theme "Transformation Education towards inclusion and quality in the context of global challenges," Mr Gqwede, Director of Adult Education for the Ministry of Education, Arts, and Culture, reported that there were still many schools in

rural areas offering ICT subjects without computers, internet connectivity, or electricity (Ministry of Education, 2022). He further suggested that ICT should be added as a key competency in the teacher education programme as well as develops and implement an IT equipment replacement plan and offer adequate IT support in schools. Another speaker, Mrs Amukana, Director of Education at the regional level, asserted that the Namibian National ICT policy is good on paper but it is not practical due to inadequate resources and an ICT support system (Ministry of Education, 2022). She further explained that there is a limited capacity to use digital technologies in teaching and learning in Namibia due to a lack of computers and electricity in some schools. As aforementioned, it was worthwhile to conduct a study on how emerging technologies (for this study, mobile learning) can be effectively integrated as a pedagogical transformative action in teacher education in the Namibian context.

4.3 Revolution of Emerging Technologies in Pedagogy - A Namibian Perspective

In order to catch up with the fast changing world, the use of innovative tools such as mobile technology for pedagogy can be said to still be in a budding process in third world countries such as Namibia (Osakwe et al., 2019). Despite the fact that most developing countries are developing policies on emerging technologies (ETs) in pedagogy, these policies have had no impact on the quality of education in these countries (Osakwe et al., 2015). Evidently, some of the recent approaches to addressing the issue of integrating ETs in Namibian schools include the provision of computers and Wi-Fi (internet connections) in schools, teacher training programmes (UNESCO, 2013), Basic Education Curriculum reform to integrate ETs (MOE, 2014), the development of the National ICT Policy (Policy, 2009), and so on. However, despite all these initiatives and policies, the actual implementation of ETs in Namibian schools tends to be slow and poor (Ministry of Education, 2022). Moreover, a guiding approach that could be followed in implementing ETs in Namibian schools, especially in low-resource areas/schools, is lacking (Osakwe et al., 2017). This has also been raised as an issue by the former Minister of Education, Katrina Hanse-Himarwa, when she stated that:

> “even schools that have ICT facilities and connectivity struggled to provide learners with the necessary skills and information as pedagogical use is low due to lack of professional development courses, pedagogical support and lack of ICT-related content.”(Smith, 2017, p. 2)

While addressing factors such as lack of electricity, teacher training, and ICT-related content, and so forth, the education policies advocate change across the system,

requiring all educators to change and innovate pedagogical practices that integrate ETs into classroom practice (see Tarling & Ng'ambi, 2016). Such educational change is crucial, and new approaches are required as more and more 21st century learners are taught to become teachers of their fellow 21st century learners. Perhaps the most efficient way to achieve the integration of ETs into Namibian schools is by using mobile technology to reach pupils in the remote areas that they can use to learn (see, Ally et al., 2014).

Most schools in Namibia do not have computers or internet access, but given the widely available mobile devices such as smartphones and the country's nationwide mobile network coverage, Namibia should find a way to incorporate mobile devices into the educational system (Absalom, 2013). The statistics depict the number of mobile cellular subscriptions per 100 inhabitants in Namibia between the years 2000 and 2018, which shows that there are 112.7 mobile subscriptions registered for every 100 people in the country (Holst, 2018). The ubiquitous nature of mobile handheld devices is making mobile learning an attractive option in education (Bikanga Ada, 2018).

A clear shift is occurring in the way mobile learning is merged to remove barriers to learning, especially in remote areas where pupils can now access learning materials from anywhere and at any time using their mobile devices. However, there is a need to transform educators' or teachers' past views (prejudice) about mobile devices so that they will be able to see their potential benefit in teaching and learning. Previous studies in Namibia reported that inadequate training, knowledge and skills and reluctance to use technology are the most common challenges among teachers in influencing their use of technology (Osakwe et al., 2017). As an intervention to this challenge, one of the approaches is to re-design a teacher training programme (see Baran, 2014) to train teachers how to use ETs in pedagogy.

Diagnosing teachers' existing pedagogical practices and the use of practical design tools intended to change teachers' pedagogic orientation, including pre-service teachers' training, will make it easier to integrate ETs into practice (Tarling & Ng'ambi, 2016). Tarling and Ng'ambi's (2016) work appears to support my assumption that if teachers (pre-service teachers) are exposed to the practical orientation of M-learning, they will be exposed to the innovative pedagogies to use mobile technologies in teaching and learning. That is, if pre-service teachers conclude that they benefited from

mobile-mediated learning during their training, such practical experience may become a habit, thereby resulting in them incorporating ETs (such as mobile technologies) into their future classrooms. An opportunity like this has not yet been extensively used for teacher education and training in Namibia (UNESCO, 2013), and this includes my own teaching practices as a teacher educator. This could be the reason why teachers were hesitant to change their pedagogical practices to incorporate ETs into their teaching; as a result, teaching with technology practices will continue to be a challenge in Namibia. Therefore, this proliferation of mobile technologies should drive a sense of urgency to use mobile devices in formal education (Ally et al., 2014; Ministry of Education, 2022) which can be applied in the Namibian context too.

4.4 Teacher Education in Namibia (IUM Perspective)

At tertiary level, the biggest institutions of higher learning in Namibia are the University of Namibia (UNAM), the Namibia University of Science and Technology (NUST), formerly known as the Polytechnic of Namibia, and the private International University of Management (IUM). The International University of Management (IUM) has its roots in the Institute of Higher Education, which was founded in 1994 and it is the sole Namibian initiative that started with one student and has now grown into an institution whose student population is currently more than 10,000 (Report, 2017). IUM obtained university status in 2002 and it was officially launched by the then state president of the Republic of Namibia, His Excellency Dr Sam Nujoma on the 26th of October 2002. The university is fully accredited by the Namibia Qualifications Authority and the National Council for Higher Education (NCHE). Furthermore, in 2019, the university was ranked as the 3rd top university in Namibia (uniRank, 2019).

The present study focused on pre-service teacher education (student-teachers) of those enrolled at IUM. The Faculty of Education was established in 2016. At the beginning, it operated only as a one-qualification faculty, being a two-year course leading to a bachelor in education: Educational Leadership, Management and Policy Honours degree. At a later stage in 2017, IUM later introduced additional qualifications under the Faculty of Education by nine (9) different qualifications, which include a three-year Diploma in Education programme; a four-year Bachelors of Education (in Pre and Junior Primary, Senior Primary and Secondary) Honours programmes; a Postgraduate Diploma in Education; as well as Master's and PHD studies. As a result of such an extension, the Faculty of Education became the biggest faculty in IUM. Currently, the

faculty comprises a total of about 7000 students across all its four campuses country wide. Consequently, IUM is the second biggest university that offers learning and training of pre-service teachers in Namibia, following the University of Namibia (UNAM).

The IUM's Faculty of Education vision strives to equip both undergraduate and postgraduate students with knowledge, skills, and attitudes. Furthermore, it aims to meet the needs and challenges of the worker of the twenty-first century while also achieving the Sustainable Development Goals (SDGs) (Report, 2017). Furthermore, the faculty aims to produce quality teachers, educators, curriculum developers, educational planners, managers, administrators, counsellors, and researchers (Report, 2017). My choice of IUM as a focus group of my study was driven by the fact that I am the Dean of the Faculty of Education and, at the same time, I teach courses such as Micro Teaching and Teaching Methods for Secondary Level, which are the subjects that are intended to equip students with the pedagogical knowledge of their specialised subjects. Micro Teaching is a first-year module, while Teaching Methods is a third-year module that is intended to prepare students for Teaching Practice in year four.

While faculty development is considered critical in adopting mobile learning practice in teacher education (Baran, 2014), the IUM Faculty of Education did not yet initiate the integration of mobile devices in teaching and learning during pre-service teacher training. Although the IUM curriculum for pre-service teachers incorporated ICT courses such as IT Skills for Teachers and Integrating Educational Technology in Teaching. During their first and second years of study, the content of these courses is primarily focused on teaching about technologies instead of students being exposed to teaching with technologies.

While I am aware that IUM students are exposed to the notion of emerging technologies in education, there is still a challenge of limited ICT infrastructure at the university, with only two computer laboratories and a few lecture halls being equipped with ICT infrastructure. However, IUM is well covered with wireless connectivity university wide as well as internet ports in all the lecturers' offices. Some students and lecturers have embraced the use of emerging technologies in teaching and learning, while others are still struggling (see Chapter Five). This became evident when the COVID-19 global pandemic outbreak unfolded, where students and lecturers were struggling to switch to online teaching and learning during the country's lockdown. Students raised the issue of

not having access to computers/PCs while other students (especially my own students) clearly indicated that they were using their mobile phones to access their schoolwork.

The COVID-19 pandemic has presented the greatest challenge that the education system has seen in recent history (Bellini et al., 2021). The pandemic has upended the operation of the education system; besides, it presents a vital opportunity to accelerate positive change in education through technology. Institutions of higher learning, including IUM, have had to adapt to new technologies and evolving student demands, embed agile education systems, build a dynamic learning environment for academic staff and students that embraces technological innovation, and align their governance models to encourage new ways of teaching and learning. In order to succeed and respond to the challenge of COVID-19, academic and research institutions were required to reimagine a different future for education (Bellini et al., 2021).

At IUM, the Moodle Learning Management System (LMS), which had previously been ignored as an online teaching and learning platform by most lecturers, was finally mandated. Prior to COVID-19, the mode of teaching and learning instruction at IUM was only done on a face-to-face basis. However, during the country's lockdown due to the COVID-19 global pandemic, all lecturers and students were trained on how to use the LMS and they migrated from face-to-face to online teaching and learning. It was during that time that IUM educators and students (pre-service teachers) were all exposed to the notion of teaching and learning with technology. The exposure of using LMS such as educational discussion forum, synchronous as well as asynchronous online teaching and learning accorded both IUM students (pre-service teachers) and lecturers (educators) opportunities to develop an interest and embrace the use of technology in teaching and learning. Therefore, I argue that pre-service teachers at IUM had both access and experience (present) with digital learning using a technological platform as compared to their past experiences. This seemed to suggest a continuous movement between their past experiences and present experiences of ETs in pedagogy, which may guarantee their understanding of mobile learning in the future.

This may in turn provide the best opportunity for IUM teacher educators to develop a culture of integrating mobile learning as one of the teaching methods during the first cohort of the pre-service teachers' pedagogical training. My assumption was that if teacher educators (like myself) find innovative ways to use ETs (such as mobile

devices) during their teaching and provide a good pedagogical model to pre-service teachers, then pre-service teachers are more likely to appreciate and experience mobile devices as teaching and learning tools. And in turn, they will be able to use other learning applications such as Padlet to create dialogues, forums, and mediate learning using mobile devices. Hence, an intervention to develop experiential mobile mediated learning for pre-service teachers can give evidence on how the fusion of horizons (between the past and the present) is contextualised to come up with new understandings and meanings of mobile devices as teaching and learning tools. Therefore, the literature review of this study was guided by the research objectives of the study to develop an intervention for pre-service teachers in Namibia on mobile-mediated action learning using mobile devices.

4.5 Chapter Summary

In this chapter, I have highlighted the literature related to the Namibian education system and its adoption of emerging technologies in education. Mobile learning or learning with mobile devices have been seen to have the potential to transform and integrate emerging technologies in the Namibian education system. The Covid-19 global pandemic has upended the operation of the education system globally. However, it presents a vital opportunity to accelerate positive change in education through emerging technologies and mobile learning. Therefore, mobile learning is seen now not as an option but a necessity for every education system in the 21st century. The next chapter (five) presents the findings from a fact-finding study and an exploration of the research problem in collaboration with practitioners as a continuation of DBR Phase One of this study.

CHAPTER 5: ANALYSIS OF A FACT-FINDING STUDY AND EXPLORATION OF THE PROBLEM
(DBR: PHASE ONE)

5.1 Chapter Overview

Continuing with DBR Phase One, this study employed the design-based research (DBR) approach, which aimed at developing educational design solutions through a systematic and iterative analysis using four phases with several interconnected research and design activities, as indicated (already discussed) in Chapter Two.

This chapter provides a summary and analysis of a fact-finding (explorative) study, representing phase One of the DBR for the study, as indicated above. In this phase, a significant practical problem for the study and its educational context is identified and explored. To identify and clarify the practical problem of mobile learning among pre-service teachers, as enumerated earlier in Chapter Two, a preliminary study was conducted to collect data from practitioners (educators and pre-service teachers) that had knowledge about the problem. As part of the preliminary study towards determining the practical problem in this study, the practitioners' use and perceptions of mobile devices in teaching and learning were examined. The relevant issues that arose during the initial study were then used to support the existing literature (see Chapters Three and Four) to identify and clarify the significance of the research problem and questions.

By structure, this chapter is divided into three sections: Section One presents the descriptive analysis of data collected from IUM pre-service teachers via an online questionnaire; Section Two presents the results of the textual analysis of the data collected from educators that participated in the semi-structured interviews via Zoom; and Section Three, which is the chapter conclusion, highlights a proposed design solution to address the identified problem, informed by the existing design principles (extracted from elements of authentic learning) embedded in AL and HLE theories.

5.2 Questionnaire Data Analysis (Pre-service Teachers' Perspectives)

Gadamer's HLE Theory requires a researcher to address issues of an individual's foreknowledge and prior experiences (Geanellos, 2000), to create awareness and reflection on their past/prejudice so that new meanings and understandings of a text will be developed. In response to this notion, the researcher deemed it crucial to initially understand the past views and experiences of pre-service teachers on mobile learning as they seem to directly own the research problem. The analysis of pre-service

teachers' past views on mobile learning was in twofold: firstly, it offers an understanding of how pre-service teachers perceived the use of mobile devices in teaching and learning; secondly, it offers an opportunity for the researcher to gradually clarify and explore the students' (pre-service teachers') problem, the characteristics of its potential solution, and the identification of technological tools and applications that appear most useful for implementing the intervention as DBR requires.

To determine the pre-service teachers' perceptions and use of mobile devices in teaching and learning, an online questionnaire web link was sent to all 195 third-year students doing the Bachelor of Education Secondary Honours Degree at IUM via their students' email addresses and WhatsApp groups. Only 114 (72 females and 33 males) of pre-service teachers responded to the online questionnaire within a period of one month. Out of 114 responses, only 105 students participated and completed the questionnaire as nine (9) pre-service teachers did not agree to the consent of participating in the study. Pre-service teachers included in this initial study were voluntary participants specialising in different fields of studies.

To ensure the validity of the questions' structure and wording, a pre-test was conducted by sharing a sample of the questionnaire with two IT educators. The purpose of involving IT experts was to tap into their expertise and gather their insights to improve the online questionnaire before it was administered to the target participants. The experts critically evaluated the wording of individual questions to determine if they were clear, unambiguous, and easily understandable by the respondents. They identified potential language barriers, technical jargon, accessibility of the application that is used (e.g., google form was used) or complex phrasing that could hinder respondents' comprehension. Finally, the experts' input, potentially, helped refine the wording of the questions, making them more concise, specific, and accessible to the target participants.

Descriptive statistics and thematic analysis were used in the analysis of the fact-finding study data obtained. Descriptive statistics were used for analyzing the data gathered through the Google Form Survey.

5.2.1 Demographic analysis of participants

The findings (see Table 5.1) showed that almost all participants (96.2%) owned a smartphone, and that a good number of them (53.3%) possessed a laptop, while 3.5% possessed a tablet and 1% an Ipad. Furthermore, all 105 participants indicated that they had been using their smartphones for academic purposes. However, while 26.7% of the participants agreed that their lecturers allow them to use mobile phones during the lessons, 56.2% said that only some lecturers allow them, while 17.1% indicated that they are not allowed to use mobile phones during lectures. The study results also revealed that participants had engaged with different social media platforms for academic purposes, with WhatsApp (100%) standing out as the most popular social media platform used by students for academic work. This implies that students use mobile phones and engage with different social media platforms for academic purposes. Thus, results show that, out of 105 participants, sixty-two (62) used Telegram, while twenty-three (23) used Facebook, twelve (12) used Twitter accounts, ten (10) Instagram accounts, seven (7) LinkedIn accounts, three (3) Myspace accounts, and one (1) TikTok account.

Table 5.1

Demographic characteristics of participants (pre-service teachers)

Characteristic	*F*	%
Age:		
20-29	96	91.4
30-39	9	8.6
Field of study		
Commerce	20	19
Science	34	32.4
Language	25	23.8
Social Sciences	26	24.8
Type of mobile device owned		
Laptop	56	53.3
Smartphone	101	96.2
Tablet	4	3.5
Ipad	1	1
The use of Smartphone for academic purposes		
Yes	105	100
No	0	0
I do not have a smartphone	0	0
If lecturers allow them to use mobile phone during lessons		
Yes	28	26.7
No	18	17.1
Only some Lecturers	59	56.2
Social media used for academic purposes		

WhatsApp	105	100
Facebook	23	21.9
LinkedIn	7	6.7
Twitter	12	11.4
Instagram	10	9.5
TikTok	3	2.9
Myspace	1	1
Telegram	62	59
Application used by lecturers to deliver a lesson		
YouTube	42	40
Moodle LMS	76	72.4
Padlet	0	0
Skype	5	4.8
Zoom	73	69.5
WhatsApp	54	51.4
None of the above	1	1

Additionally, results revealed that lecturers are also embracing the use of emerging technologies in teaching and learning. This is evidenced by 72.4% of participants indicating that their lecturers used Moodle LMS to deliver a lesson(s). Furthermore, while 69.5% of participants said that their lecturers used Zoom to deliver a lesson(s), 51.4% said their lecturers used WhatsApp, and 40% said their lecturers used YouTube. No lecturers were reported to have used Padlet to deliver a lesson(s). These findings suggest that students have been engaged in some sort of online learning platform through electronic devices, including mobile devices. This implies that students (pre-service teachers) are more likely to engage in technological interventions (using mobile devices) and applications such as Padlet (the selected mobile applications for this study) for teaching and learning.

5.2.2 Use of mobile devices for academic purposes

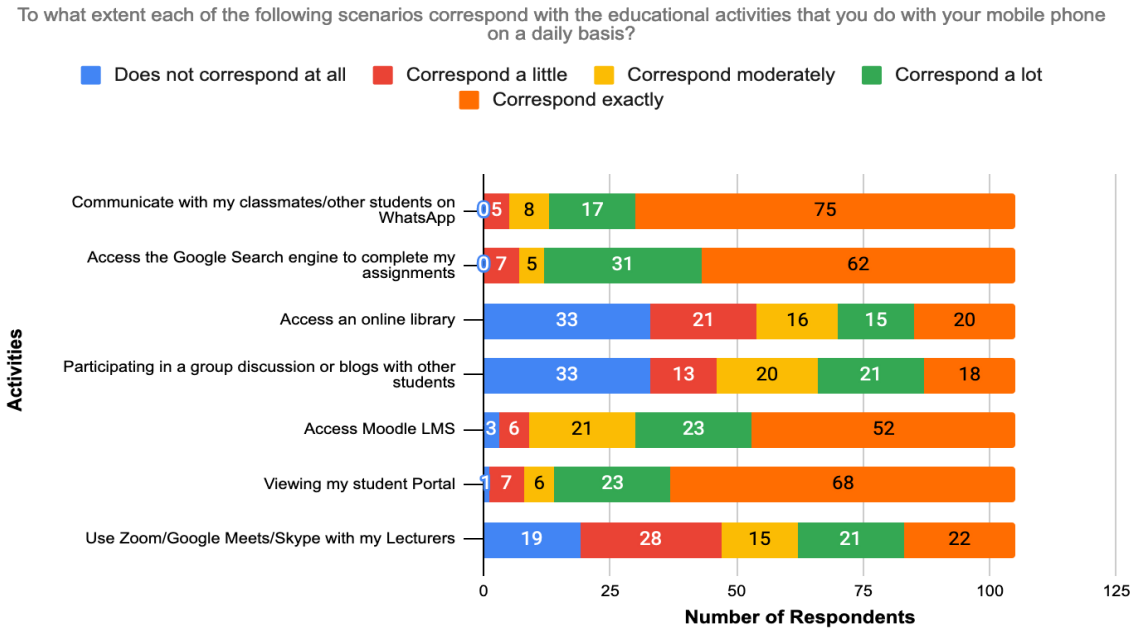
In order to examine the extent to which students use mobile devices for academic purposes and their perceptions of the usefulness of mobile devices in teaching and learning, a series of 5-point Likert-type questions (ranging from always used to not used at all; extremely useful to not useful at all; corresponding exactly to does not correspond at all; and strongly agree to strongly disagree) were developed as part of the questionnaire. The said questions are 10, 11, 12, and 17 (Questions 10 & 11 are interrelated) on the questionnaire.

Question ten asked students to identify the device(s) they most used to complete assignments and academic work (Smartphone, Desktop PC, Laptop, IPad, and Tablet). Results show that the smartphone (46.7% always used, 34% moderately used, and

17% most used) is the most popular device used by students, followed by laptops (16.2% always used, 33% moderately used, and 25% most used). The least used device is the desktop PC (17.1% moderately used, 34% least used). The iPad and tablets were rated by the students as the least used, with only 1% being mostly used by them. The device(s) that pre-service teachers use to access online learning materials was the subject of Question 11. The results show that most of the pre-service teachers (47%) access their online learning materials via Smartphone/Tablet/iPad (47%), followed by Laptop/Desktop PC (23%), and this nearly corresponds with the response on the most popular device. The use of a friend's or classmate's phone did not correspond with many pre-service teachers, with only 2.4% corresponding exactly and 57% not corresponding at all. These findings appear to indicate a significant relationship between the most popular device (Question 10) and the device used by students to quickly access online learning materials and information everywhere (Question 11), thus, significant use of smartphones, which are mobile devices. There is, therefore, a need for further probing to confirm the evidence, and hence this research intervention (see Chapters 8, 9, 10) probed further into this.

Figure 5.1

Activities that pre-service teachers do with their mobile phones daily



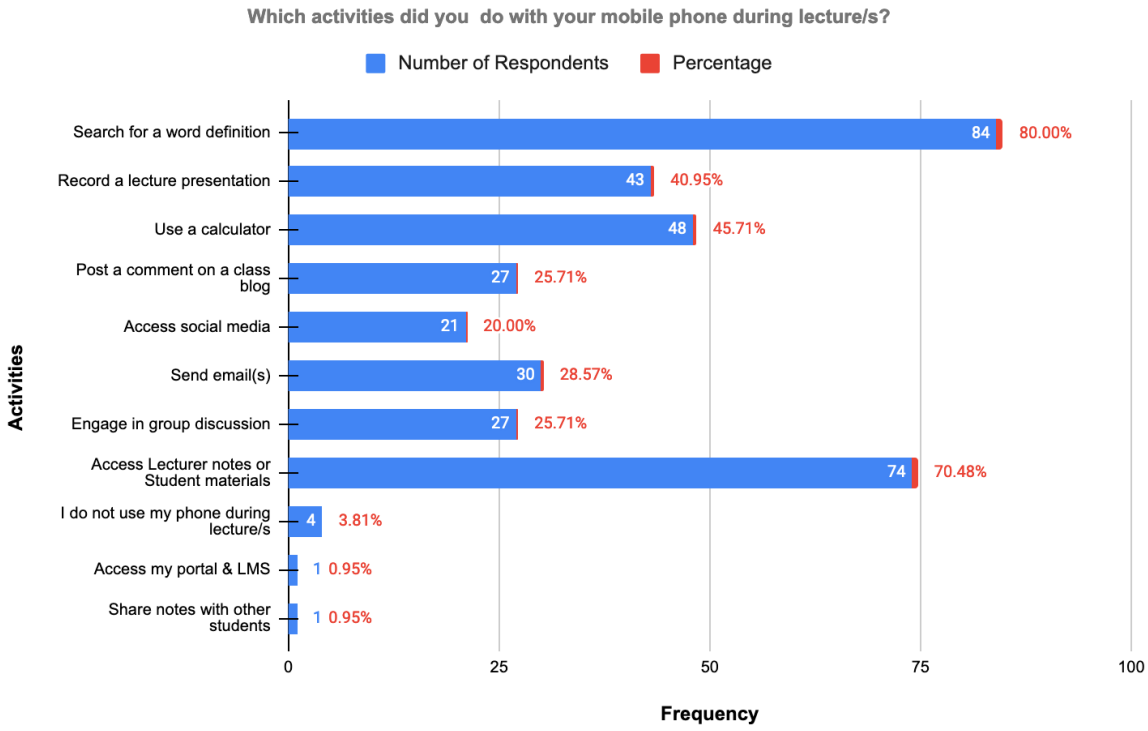
Note: This figure presents the findings of educational activities that pre-service teachers use with their mobile phones daily, responses to question 12 in the questionnaire. Own work

Figure 5.1 shows the results of the educational activities, websites, and mobile applications that students (pre-service teachers) frequently use on their mobile phones daily. Among the responses from 105 students, prominent ones are communication with their peers (71.4%, n = 75), accessing their IUM students' portal (65%, n = 68), accessing Google search engine to complete assignments (59%, n = 62), and accessing Moodle LMS (50%, n = 52). Furthermore, the use of Zoom/Google meet/Skype calls (21%, n =22), access to the online library (19%, n=20), and participation in class group discussions and blogs (17.1%, n=18) are among the few activities that students associate with what they do with their mobile phones daily.

These findings are an indication that the use of mobile phones for academic purposes in students' daily lives (with the use of WhatsApp as the most popular platform among pre-service teachers) is common, hence creating the potential challenge to the existing ways of thinking and potential use of mobile devices for teaching and learning to the optimum.

Figure 5.2

Activities that pre-service teachers do with mobile phones during lectures



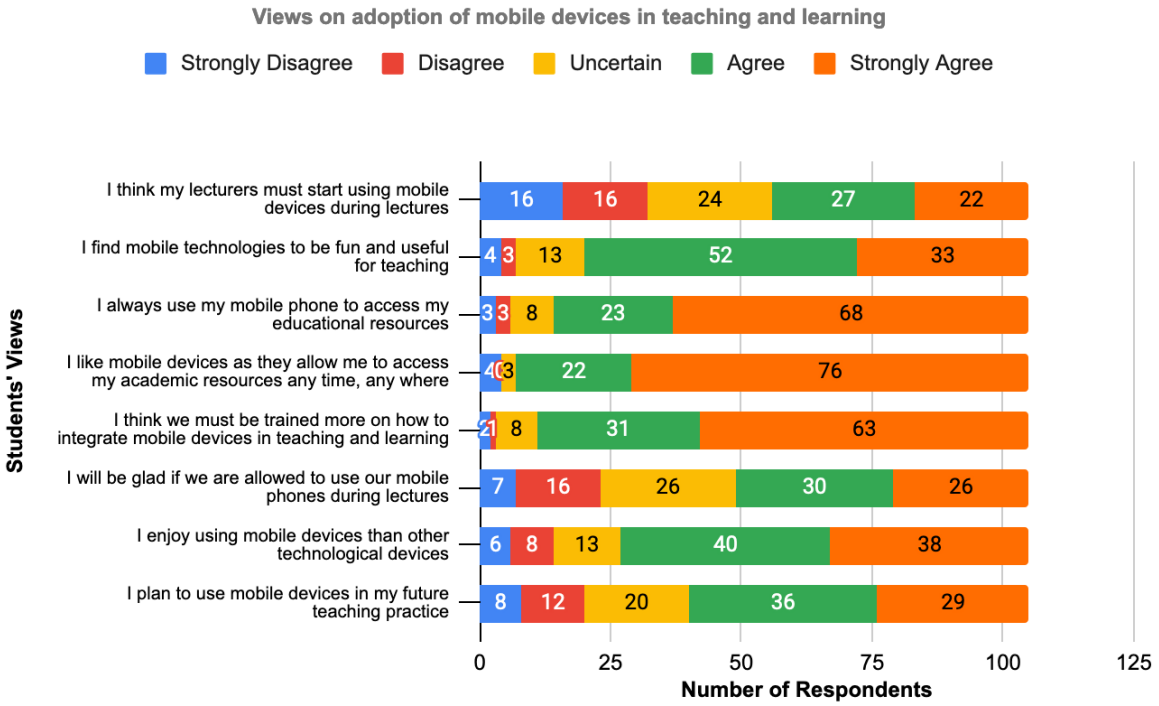
Note: This figure presents the findings of activities that pre-service teachers use with their mobile phones during lectures, responses to question 15 in the questionnaire. Own work

Figure 5.2 indicates the activities that pre-service teachers do with their mobile phones during lessons. The results show that the students (80%) are most often heavily engaged in word definition searches and 70.48% access lecture notes and/or student materials. The activities with relatively low scores include the use of mobile phones to post comments on class blogs (25.7%) or engaging in group discussions (25.71%).

Results shown in Figure 5.1 and Figure 5.2 respectively; show evidence that students use their mobile devices before, during, and after lectures for educational purposes. However, it also appeared that they mostly used their mobile devices as tools to access educational information and/or online resources rather than using them as an engaging teaching and learning tool. This is reflected by the results in figure 5.3, which show the pre-service teachers' views on the adoption of mobile devices for teaching and learning.

Figure 5.3

Pre-service teachers' views on adoption of mobile devices in teaching and learning



Note: This figure presents the findings of pre-service teachers' views on the adoption of mobile devices in teaching and learning, responses to question 1 in the questionnaire. Own work

Following figure 5.3, most of the students, that is, 76 (72.3%) of 105, strongly agreed that mobile devices allowed them to access their educational resources anytime and anywhere, while 21% (n = 22 strongly agreed) and 25.7% (n = 27 agreed) that lecturers

must start using mobile devices during lectures. The students (60%, n = 63 strongly agreed; 29.5%, n = 31 agreed) agreed with the notion of being trained further on integrating mobile devices into teaching and learning. This is interesting to note, especially the mixed feelings that they have on the integration. This finding suggests that pre-service teachers' pre-understanding and previous views (prejudice) can influence their judgment on the use of mobile devices for teaching and learning, and consequently, its adoption or not.

Figure 5.3 also revealed that only a few respondents (19%, n=20) disagreed about their possible future use of mobile devices for teaching practice and felt that lecturers should not be allowed to use mobile devices during lecture(s), with no significant differences in their disagreement with the idea of them being allowed to use their mobile phones during lectures. The result is an indication that a pre-service teacher owning a mobile device does not automatically translate to them using it for teaching and learning and, hence, may be using the device for other purposes, for example, as social technological tools. For one to use a mobile device for effective teaching and learning, there is a need to construct a mobile-mediated learning experience so that the person will be able to observe and learn how to use the mobile device effectively. The evidence above revealed that most respondents (47%, n-49) are willing and agreed to be trained on how to integrate mobile devices into pedagogy, hence the need to develop a mobile-mediated learning experience framework to guide pre-service teachers and teachers in this process.

5.2.3 Use of mobile devices for learning and future teaching

To further support the data collected from the Likert-scale and closed-ended questions in the questionnaire, open-ended questions (qualitative questions) were also developed to uncover pre-service teachers' motives and perceptions for using mobile phones for teaching and learning in the future in the classroom. Tables 5.2 and 5.3 present the results of the qualitative data analyses.

The analysis of each qualitative question is divided into four parts: the arising theme from the respondents' responses; the number of respondents that responded to the theme; salient respondents' comments; and the researcher's brief discussion of respondents' responses. The results are grouped in a tabular form per generated research theme as explained earlier in Chapter Two.

Table 5.2

What do you consider to be the most satisfying use of mobile phones in learning as a student (Question 18)

Themes formulated from pre-service teachers' responses	Number of participants out of 105	Salient pre-service teachers' comments	Researcher's comments
Accessing information/learning materials anytime	57	"…fast access to academic information", "…you get to access your notes anytime.," "… to search information on different platforms other than taking time to go to the nearest library." "…it makes learning materials available always." "…students keep on revising their lessons at their own pace." "…the fact that I carry it with me everywhere I go and still get access to academic (materials) wherever I am." "…Google answers." "…watch academic YouTube videos when laptop is out of reach."	Pre-service teachers use mobile devices to access and search for information, it points towards being able to use mobile devices for academic research which is very important in academic achievement. The fast accessibility and portability of mobile devices could influence their interest in using mobile devices /phones to do online research.
Fast and easy communication /collaboration	21	"…the use of WhatsApp to communicate." "…it's fast and easy communication if all students have access to internet connections." "… easier for us students to communicate with each other as well as with our lecturers." "…they are fast to send and receive information." "…group discussion." ... Participating in discussion e.g. on LMS, WhatsApp."	The fascinating feature of mobile learning is communication among the students as they can send their queries via WhatsApp which appears to be the most popular App among the pre-service teachers (see Table 6.1) and getting feedback immediately either from their peers or lecturers. Lecturers can easily update electronic learning materials and share them with students immediately. The use of mobile devices for collaborative interactions among the students also appeared to be evident.

		"... engaging in a forum classroom discussion is beneficial."	Students consume and exchange information along with the opportunity of creating socially interactive environments with their peers and lecturers.
Usability and access to information	19	"… easy to use." "…easy to use in accessing academic resources." "…easy to use and used anytime and anywhere." "…typing is made easier with words suggestion list." "…it's user friendly and portable." "...buying data to use the phone is cheaper."	They find mobile technology easy to use, affordable and portable where they can access their learning materials anytime and anywhere. This implies that a clear shift is occurring in the way mobile devices are interpreted by the students, which makes it crucial to implement mobile learning in education.
Accessing Moodle LMS or Student Portal	15	"…accessing my portal." "…we communicate fast and with ease with other students, we can also go through our portals and Moodle LMS." "…to access lecture notes on the LMS."	Since they already use their mobile devices for a variety of educational activities, they will expect to be able to use their existing mobile technology to participate in online teaching and learning platforms such as Moodle LMS etc.

The responses show evidence that pre-service teachers are aware of the learning that is mediated by mobile devices. This question was important for two reasons: firstly, to understand the students' pre-conditioned views about mobile devices as a learning tool; at this point, pre-service teachers were influenced to reflect and revisit their past experiences or past understanding of mobile learning, as Gadamer's theory of HLE postulates. Secondly, it enabled the researcher to address and understand the issues of prejudice which may influence the students' judgement on what mobile devices can only offer from a learner/student perspective. Based on these initial findings, it is evident that students are heavily engaged in accessing learning information and materials (54.2%) through the Google search engine. Other teaching and learning activities that they find most satisfying in using mobile phones include communication with peers and lecturers (20%; n = 21), accessing information (18%, n = 19), and Moodle LMS or Student Portal (14.2%, n = 15). The findings suggest that they were not yet fully using their mobile phones to their great potential for teaching and learning purposes. M-MLI is therefore

needed to provide an opportunity for pre-service teachers with observable concrete examples of learning mediated by mobile devices from a student's perspective. This study therefore works towards a M-MLI as presented in Chapters eight, nine, and ten.

Table 5.3 presents a summary of the findings on students' perspectives about the satisfactory use of mobile phones in their future teaching classroom. Results for questions 19 and 20 were merged in this section as they had repetitive and complimentary themes and responses from the respondents

Table 5.3

Do you think you will use mobile phones as part of your teaching in your future teaching classroom? (Question 19 and 20)

Themes formulated from pre-service teachers' Reponses	Number of participants per theme out of 105	Salient pre-service teachers' comments	Researcher's comments
Causes distraction in class	31	"NO …learners will not concentrate (during the) lessons." "NO …phones can sometimes be interruptive." "NO …some of the learners will not focus in class." "NO …it can bring distractions in my class." "NO …not to be disturbed by notifications during the lessons." "NO…one can receive a call while busy teaching or open an App accidentally." "NO …if a teacher integrated it in class he/she may fail to discipline him or herself." "NO …most of our schools are still far from technology thus it will bring confusion (among) learners."	Negative perception about using mobile devices in future teaching must be addressed. To implement mobile learning, it requires innovation, special training, technical support and availability of mobile technologies. Ethical concerns such as misusing mobile devices during a lesson by accessing inappropriate apps, websites etc. are keeping future teachers from embracing the full potential of using them in their future classroom. The safety and online security of using mobile devices for learning need to be understood
Makes teaching easier	25	"YES…it will make teaching easier." "YES...will satisfy me on what am going to teach by	The motive of pre-service teachers to use mobile devices in their future teaching suggests that

		navigate the google chrome." "YES … I'll get more information from Google chrome regarding the subject matter." "YES …make my learners understand after showing them the actual thing." "YES, …to show the learners what I'm teaching them." "YES …to enable learning to be effective, in case I want to quickly search for information on the Internet." "YES …by making my students listen to educational audios." "YES … use the apps to learn about subjects." "YES … record the lesson and send it to my learners." "YES …engage in mobile classroom forums."	learning mediated by mobile devices could enhance teaching and learning through creating and sharing information, research, use digital online content, blogs, forum discussions, and authentic e-learning
Access teaching information/notes	20	"YES … I'll get more information from Google chrome regarding the subject matter." "YES …if I am explaining /demonstrating something and the learners look confused I can just show them on the phone." YES... I can use it to show my students online examples of whatever topic I'm teaching that day." "YES …to avoid the problem of learners forgetting their notebooks at home." "YES …because I will search the unknown words."	Pre-service teachers' views show that the use of mobile technologies as a teaching tool will enable them to quickly access teaching materials that match the desired learning outcome for the lesson, subject, unit or course Learning materials/notes will be available in electronic repositories to access them anytime and anywhere.
Collaboration /social interaction	14	"YES, …I would create a WhatsApp group for my learners …share notes in pdf form." "YES …using google classroom or zoom,	The views of the students suggest that mobile devices in teaching and learning could create a high degree of collaboration and social interaction among the

		especially when I am sick or not around in school." "YES …I will upload videos on my google drive that will be accessible by learners." "YES …discuss what my learners understand/don't on WhatsApp." "YES …to engage with learners." "YES …by creating blogs and websites for my learners." "YES …by creating revision podcasts and creating WhatsApp group." "YES …during weekends I can give the learners a few tasks to do while at home."	learners and teachers mediated by a mobile device. Different m-learning activities such as having discussions about the subject topic; sharing podcasts, videos and notes; using blogs, Zoom/google classroom etc. will be done via mobile device.
Affordability/usability	6	"NO …I will find other devices useful for classroom teaching, … I will use a laptop and a projector." "NO …because it is expensive and not all learners can afford everyday data." "NO …if you are teaching at remote areas these people (learners) won't be able to own ~~either~~ a smartphone or data every day." "NO …the mobile phone is small, (for) instance I want to show my learners something they won't be able to see properly."	Students perceived the use of mobile devices in teaching as not useful by addressing the challenges of *affordability* (to buy a smartphone and internet data bundles) and the *usability* (small screen and key button) of mobile phones.
Phones ban in schools	3	"NOT really, … some school policies (stated) that no mobile phones are allowed during teaching." "NO …because majority of the school kids don't have smartphones, and those that have, the phones are not allowed in schools."	Banning of mobile phones in schools must be lifted for the possibility of adopting them in teaching and learning.

The above findings show that 62 out of 105 students said YES, they will use mobile phones in their future teaching classrooms, while 40 students (38%) said NO, they will not use them, and 3 students (2.8%) said they are not sure. The results further show that those who said YES identified the benefits of using mobile phones as; making teaching easier (23.8%, n = 25), accessing teaching information/notes (19%, n = 20) and collaboration/social interactions (13%, n=14), while those who said NO identified the challenges of using mobile phones in teaching such as causing distraction in class (29.5%, n = 31), affordability and usability of smartphones (5.7%, n=6) and phone ban in schools (2.8%, n=3). The students' responses above partly provided evidence of students' awareness of teaching mediated by mobile devices. It also revealed students' pre-conception and preparedness about the use of mobile devices in their future teaching classroom. These findings further show that students are not yet exposed to the innovative pedagogies and technological enhancements that mobile phones can offer for teaching and learning. It is, therefore, not surprising that some students are not in favour of the use of mobile phones during teaching, as they see it as possibly causing distraction in class.

5.3 Analysis of Interview with Educators and Practitioners

This thesis used a design-based research (DBR) framework that enabled the researcher to collaboratively work with other education practitioners to refine the research focus and problem. To explore the empirical analysis of educators' experience on the use of mobile devices and educational technologies among educators, a semi-structured interview was developed to gain a more robust understanding of the phenomena in developing a mobile-mediated intervention and learning environment.

To carry the above forward, an invitation to participate in the study was shared online and a consent form web link was shared with the identified twelve (12) educators in the Faculty of Education and two (2) IT practitioners in the Faculty of Information and Communication Technology (ICT) at the International University of Management (IUM). A total of 13 educators agreed to participate in the study and they completed the consent form. From the total respondents, six (6) participants were purposively and conveniently sampled for the interview. The six (6) participants included four (4) educators from the Faculty of Education who teach teaching methodology modules (for Languages, Science, and Social Sciences) and two (2) educators from the ICT department who teach IT skills and Integrated Technology in Education modules for

pre-service teachers. Data was captured via Zoom recording. The interviews with practitioners did not only allow the researcher to discuss issues with the educators in detail but also prompted new questions for further clarity. After the interviews, the recorded interview responses were transcribed and content analysis was undertaken. A thematic analysis was used for analysing interview transcripts and open-ended questions using a Microsoft Excel sheet to sort, categorise, re-read, and code categories according to the themes that emerged from the data. For easy classification and reference purposes, the interview responses were tabulated as in Tables 5.4 and 5.5 below.

The focus of this phase of the study was mainly to diagnose educators' existing pedagogical practices and use of practical educational design tools in their teaching practices. The initial instance was to first analyse the researcher's own experience as I (an educator) have been integrating the notion of emerging technologies in my own teaching practices. To move my own experience forward and wider in the context of this study, the need to intensively collaborate with other educators to understand how they disposition and conceptualise the use of mobile devices and emerging technology in pedagogy was crucial. This also assisted me as a researcher to develop appropriate solutions and draft design principles (as per DBR guidelines) for M-MLIs that seek to address the identified problem for this study.

The interview for scheduled educators was aimed at finding out the pedagogical techniques that educators were using to respond to the 21st century demand of integrating emerging technologies in education; the perspectives and attitudes of educators towards the use of mobile phones during lectures; their views on the usage of online resources and technological tools used in pedagogies; the appropriate approach of training pre-service teachers to acquire knowledge of integrating technology in their future classrooms; and their views on the integration of mobile devices during pre-service teachers' training.

Profiles of responding educators are presented in Table 5.4. As highlighted in Table 5.4, the six (6) educators are coded as Ed1, Ed2, Ed3, Ed4, Ed5, and Ed6 for ethical and anonymity reasons. Table 5.4 also shows that the educators' lecturing experience ranged from 5 years to 16 years, and both genders were represented as four (4) males and two (2) females participated in the interviews. The participants' ages ranged from

30 to 50 years old. Of the six educators, two (2) participants have PhD degrees, while all four (4) have Masters' degrees as their highest qualification.

Table 5.4

Profile of educators that participated in the interview

Educator	Sex	Age	Years of lecturing	Module taught	Highest Qualification
Ed1	Male	30-39	13 years	Basic IT skills for teachers	PhD in Information Technology
Ed2	Male	50+	16 years	History of Education (Teaching methodology)	Master in education
Ed3	Female	40-49	7 years	English Language (Teaching methods)	Master in education
Ed4	Male	40-49	5 years	Science (Teaching methods)	Master in theological studies
Ed5	Male	30-39	10 years	Integrated Technology in Education	Master in business administration
Ed6	Female	30-39	4 years	Geography (Teaching methods)	PhD in education

As mentioned earlier, purposive sampling was used so that educators who are teaching the selected course modules (teaching methods for science, commerce, social sciences, and language) for the study were selected as practitioners in the field. These (teaching methods subjects) are the third-year pre-service secondary education teachers' modules that are intended to equip students with the pedagogical knowledge of their specialised subjects and prepare them for teaching practice in their final years.

To summarise the experiences, perceptions, and views of the participating educators in relation to integrating emerging technologies into pedagogies, Table 5.5 shows the responses of each educator to the research interview questions (see Appendix B) and themes. In Table 5.5, educators' responses to each interview question are summarised. Only the most important and similar themes, patterns, and relationships that are aligned with the integration of technology in pedagogies were highlighted.

The finding of research question one (RQ1) indicated that educators at IUM are using diverse kinds of technologies to enable teaching and learning in courses that they teach. These technologies include an LMS (such as Moodle), classroom technologies such as projectors and smart boards, and social media/instant messaging tools (such as WhatsApp/Facebook/Emails).

Table 5.5

Summary of responses of educators/practitioners

Educator	**Educators' responses/views per Research Question (RQ) theme**				
	RQ1: Integrating technologies in education	*RQ2: Use of mobile phones during lectures*	*RQ3: Online resources and technological tools used in pedagogies (were they useful or not)*	*RQ4: Appropriate approach of training pre-service teachers for future teaching*	*RQ5: Integration of mobile devices during pre-service teachers' training*
Ed1	Using LMS (such as Moodle, SAKAI, D2L, Fronter); Classroom technology such as projectors and smart boards; instant messaging; video conferencing	Yes, using it during lectures, accessing information; run programme on online platform for practicals	YouTube, WhatsApp, LinkedIn, Facebook, LMS, video conferencing- *found very useful*	Model the appropriate use of technology in teaching	Yes, is a powerful tool that we always use in our classes even if it is not formally addressed or allowed in class
Ed2	Using overhead projector during lectures; Video conferencing; Google search information and sharing with students; Instant messaging via WhatsApp	No, it causes disturbance	online journals; open access book; different search engine; Zoom; Google meets; Skype; BBB; YouTube; WhatsApp etc. - *found very useful*	They must be trained with technology; must be shown how to teach with latest technology; educators must be trained too, to model to the students; They need a lot of practice	Yes, it will make learning possibly make learning; the must own smartphones; Phone ban in schools must be addressed
Ed3	Using overhead projector during lecturers; Use Moodle LMs to	Yes, allow students to search meaning of words and information	LMS, google classroom, YouTube, google meets; WhatsApp – *Some useful*	Be creative and flexible; be able to teach anywhere; show them	Yes, start teaching them how to use their mobile phones in

	post teaching materials	related to the topic for the day	*some not*	how to use technology in teaching; lecturers must be trained too;	teaching; Phone ban in schools must be lifted.
Ed4	Using overhead projector during lectures; Post materials on WhatsApp, Moodle LMS and emails;	Yes, accessing notes and material posted on LMS or shared a previous day, search for materials related to the topic	LMS; google meets; YouTube; Zoom; BBB – *some useful, some disruptive*	-train student with technology; train lecturers too; provide technologic al devices to students	Yes, it is convenient, control is required to avoid disruption
Ed5	Modelling different tools of educational technologies; use Moodle LMS; engage with students through WhatsApp/Em ails	Not always, depends on the activity; use WhatsApp during lesson; manage to monitor what to be posted on WhatsApp group	LMS, Zoom, Google classroom, *very useful when well monitored*	Model how to use technologic al tools to students	Yes, makes teaching easy; make phones legal in class; monitoring in place
Ed6	Using the overhead projectors, send notes via emails and WhatsApp	Yes, students to access their notes and LMS	LMS; Google meets; WhatsApp; Zoom - *found very useful*	Train lecturers; train students by example; students to practice how to teach with technology	Yes, if they are observed well not to use it for other purposes, policy to be in place to allow phones in schools

They have also indicated that they use video conferencing software such as Zoom, Big Blue Button (BBB), Google Meet, and Skype. However, the responses appear to indicate that only educators teaching IT modules (Ed1 and Ed5) are well-versed on how to teach with technology; thus, educators teaching education modules appear to be exposed to the concept of technology integration in teaching, but their knowledge

appears to be limited to the use of overhead projectors and instant messaging tools, as well as information sharing and communication with students.

In response to RQ2, Ed1, Ed3, Ed4, Ed5 and Ed6 responded that they allow students to use their mobile phones during face-to-face contact sessions. But Ed3, Ed4, and Ed5 indicated that they only allow students to use their mobile phones to search for the meaning of words or access lecture notes and material on the LMS. Furthermore, Ed1 and Ed5 said that sometimes they request students to use their mobile phones as part of real-life learning class activities to enhance learning. Based on this point, educators allowed their students to use mobile devices during teaching for information sharing purposes. However, as technology continues to play an increasingly significant role in various aspects of life, it is crucial to equip students with the necessary digital literacy and 21st-century skills. By integrating mobile devices as teaching and learning tools, for instance educators can help students develop competencies in information literacy, critical thinking, digital communication, collaboration, and problem-solving through mobile learning applications such as Padlet. These skills are vital for success in the digital age and future career readiness.

In response to research question three (RQ3), all educators indicated that the role of technology in teaching is useful and has the potential to mediate learning using a variety of tools or platforms. However, some educators (Ed3, Ed4, and Ed5) pointed out the contraction, while at the same time acknowledging the benefits. For instance, Ed6 commented:

> *"Make them (students) aware of the different types of technology that are available to teach because most of the time students and people out there are discouraged to use technology in class because sometime they are disruptive, not productive at all, but if you look at the good side of it, if we engage, because remember most of the people, especially the young ones, are attached to technology, but if we transform it and use it in such a way that it can be productive, like in classrooms, I think it will be fine."*

When educators were asked what the appropriate approach to training pre-service teachers is to be able to integrate educational technologies into their future teaching (RQ4), all educators commented on the notion of providing activities that model real-life use of different technologies in teaching. For instance, Ed2 stated that "as lecturers we should be using the technology, they (students) should see us using it. If they see us using it, then they can use it later." Some educators (Ed2, Ed3, Ed4 and Ed6) also

indicated that lecturers must be trained on how to use technology as a tool to mediate learning rather than as a tool to access information and social activities. The responding educators also warned, however, that this could only be feasible if students were all equipped with technological devices and had access to the internet, as these are the major challenges that students or learners in schools are facing.

Finally, the last research question (RQ6) was about educators' views on whether mobile devices (such as smartphones and tablets/iPads) must be used during student-teachers' training. The findings show that all educators saw the potential of using mobile phones and devices in teaching and learning. However, some educators (Ed1 and Ed4) felt that using mobile phones during face-to-face contact sessions could be disruptive and that students might use them for social purposes rather than learning purposes. Also, some educators warned that the policy that banned mobile phone use in school is an obstacle, and unless that policy is revised, the use of mobile phones in school might not be possible. For example, Ed1 commented:

> *"I'm sure that time will definitely catch up with us, and COVID-19 proved to us that time is catching up with us. Teaching with mobile devices is something we cannot do without and... teach your students teachers…allowing them to practice with their mobile devices and teaching them on how to teach online, in terms of their training period years is very important to allow that. And one thing personally I look forward to is if it is possible to push for a review of that existing policy to allow use of mobile phones in classrooms. "*

The above findings imply that teacher educators have shown an interest in the integration of mobile technologies into the teacher education context. However, they (educators) commented on the challenges to the adoption of mobile devices into pre-service teachers' training programmes and as a teaching/learning tool. These challenges include: teacher educators not effectively prepared on how to teach with mobile technologies and being able to model good practice to preservice teachers (see Baran, 2014); lack of support in terms of policies such as prohibition of phones usage in schools/classroom and other curriculum issues; internet access and mobile data is expensive and learners might not afford it, especially in resource-constrained communities; affordability of buying a smartphone; ethical concern of using mobile phones during the lesson; cause of distraction during the lesson if not well monitored.

5.4 Chapter Summary

In conclusion, the analysis and exploration of the practitioners' view of mobile mediated learning among educators corresponded with the findings of the participants' (pre-service teachers') views of mobile-mediated learning experiences. Findings from both educators and students consolidated the important aspects of integrating mobile technologies into pre-service teachers' training. The results from the fact-finding study revealed the need to educate both educators and students on how to integrate mobile devices as a teaching tool and the importance of this. On the other hand, the need to model (provide authentic context) the effective use of mobile technologies in teaching and learning seems more imperative and required. Furthermore, the need for more technical support and the provision of mobile devices to students and learners, especially in the resource-constrained environment, should be noted too.

For this study, using the theoretical framework of action learning (authentic learning context) with the support of the Triadic Zone of Proximal development framework (to address the notion of learning technologies in resource constrained environments), HLE theory, and the results from the fact-finding study above, the researcher was guided in constructing the design of M-MLIs. The next chapter (six) presents how the theoretical and conceptual framework was used to design a learning solution that addresses the research problem for this study and the introduction of Phase Two of DBR.

CHAPTER 6: THEORETICAL AND CONCEPTUAL FRAMEWORK OF THE STUDY
(DBR: PHASE TWO)

6.1 Chapter Overview

Given the notion of developing experiential mobile-mediated learning for pre-service teachers, I have argued that student teachers must be engaged in action mobile learning wrapped in reflection so that they can reflect on different accounts of the past and contextualise them to come up with meaningful conclusions. Therefore, for this study, I used two theories that helped me to understand and support the study, which are HLE theory and AL theory. This chapter presents the theoretical and conceptual framework of the study and the introduction of Phase Two of DBR.

6.2 Underpinning Constructs of the Study

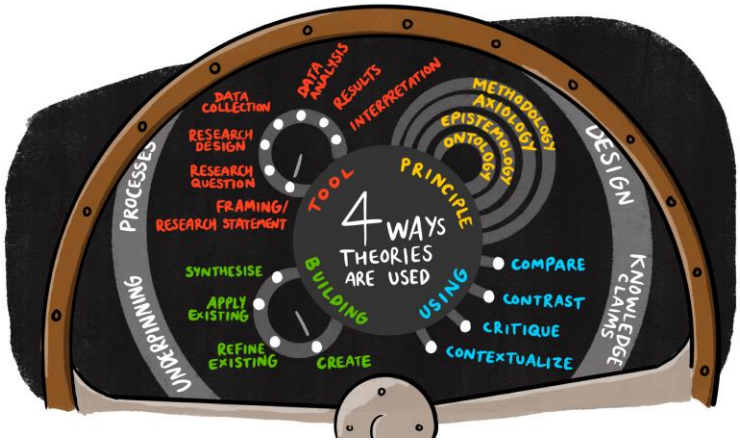
According to Farrow et al. (2021), contributions to policy and practice through research should be considered in the context of underpinning models, frameworks, and or theories. The research's underpinning constructs can take a variety of different forms (Farrow et al., 2021) and should be carefully selected or even developed to relate to contexts and circumstances (Passey, 2020). Concurring with Oliver (2002), Passey (2020) makes a distinction between four fundamental ways that theories are used in research. Farrow et al. (2021, p. 24) summarise these four different ways to use theory in a research study as follows (see Figure 6.1):

- *Theory as tool* - used throughout the research process
- *Theory as principle* - informing methodological and philosophical position
- *Theory building* - created a new, or refined/synthesized from others
- *Theory using* - engaging with knowledge claims

Passey (2020) suggests that "one way to consider the reasons why theoretical or conceptual underpinnings might be used, and the practice of how, is to explore different elements of a study, and how they are related" (p.11). Passey further emphasises that in a single research study, if different models, frameworks, or theories are chosen, they must be aligned with each other, explained clearly, and aligned paradigmatically so that their relationships are well understood. Subsequently, Passey suggested five elements of a study to be considered: (i) ontological and epistemological position, (ii) methodological approach, (iii) methodological design, (iv) data collection methods, and (v) data analysis methods.

Figure 6.1

Uses of Theory in Research



Note: This figure summarises four different ways to use theory in a research study. From “Theories, theoretical and conceptual frameworks, models and constructs: Limiting research outcomes through misconceptions and misunderstandings," by D. Passey, 2020, Department of studies in technology enhanced learning. https://stel.pubpub.org/pub/01-01-passey-2020/release/. CC-By 2.0

Following Passey’s suggestion on the five elements of the research and approach, Table 6.1 represents the underpinning construct of this study and how each element was positioned in the study. This study adopted two theories: Hermeneutic Learning Experiential (HLE) Theory by Gadamer (1900–2002) (representing the theoretical framework) and Action Learning (AL) Theory by Revans (1980) (representing the pedagogical framework). The methodological approach chosen for this study is framed within the constructivism paradigm (Bruner, 1990) (see Chapter Two, section 2.3). In the following section, I present how HLE and AL theories were applied in this study.

Table 6.1

Underpinning Constructs of the Study

Elements of the research and approach	Position or stance, and implications	Underpinning constructs
Focus or title of the study	Towards a mobile-mediated action learning experience for pre-service teachers	Action Learning theory and Hermeneutic Experiential learning theory were applied
Ontological and epistemological position	Ontological position is subjective, concerned with the interpretation that pre-service teachers’ fusion of horizons brings Epistemological position is	Constructivism as an overarching theoretical conception was adopted Epistemological concepts that are derived from the theory of

	constructivist, concerned with pre-service teachers' constructions of reality and knowledge	Hermeneutic Experiential learning theory were applied
Methodological Approach	The methodological approach is interpretivist, related to a subjectivist position, within an educational settings/context and considering multiple meanings/iterations	Contextual constructivism as a more related theoretical framework is chosen
Methodological Design	From an interpretivist perspective, a M-MLI iterative cycle was used to consider different contexts, and to gather evidence of how mobile-mediated learning experiences influenced pre-service teachers' views of using mobile devices in teaching and learning	Design-based research theory is applied, framed within the theory of Action Learning
Data Collection Methods	Data were gathered in three iterative cycles of M-MLI following a design-based research approach A fact-finding study gathered evidence on preconception and pre-judgement of mobile devices in teaching and learning among the students and educators where a mixed method was used	The logic of mobile-mediated learning inquiry is inductive and is based on the interpretation of multiple iteration which was framed through Action learning theory
Data Analysis Methods	Data were analysed both qualitatively and quantitatively, from interpretivist and subjectivist perspectives	Data were analysed using interpretative phenomenological analysis and hermeneutic cycle driven analysis

6.3 Hermeneutic Learning Experience (HLE) Theory

The philosophical underpinning deemed useful to this study was linked to the works of the German philosopher Hans-Georg Gadamer (1900–2002). Fundamental to Gadamer's work is the concept of understanding. He developed a philosophical perspective in his work 'Truth and Method' and explained a process of philosophical hermeneutics (Clark, 2008). According to Gadamer (1975, p. 87), understanding is not "an isolated activity of human beings, but a basic structure of our experience of life" (as cited in Jacobs, 2014, p. 301). "Hermeneutic" is the method of interpreting the meaning of a text. It can be applied to a text that is difficult to understand and requires effort to interpret, based on the changes in the world. In hermeneutics, "it should be noted that "text" not only refers to the written transcript but also to taped words, written comments about the interview situation, and observations made by the researcher" (Fleming et al.,

2003, p. 118). In this study, text was interpreted in terms of students' artefacts (such as discussions, observations, audio-recorded words, bog entries, etc.) that were influenced by mobile-mediated learning experiences.

The central phenomenon in this hermeneutic understanding is the traditional hermeneutic circle. A hermeneutic cycle is defined as "a methodological process or condition of understanding, namely that coming to understand the meaning of the whole of a text and coming to understand its parts were always interdependent activities" (Schwandt, 2001, as cited in Kinsella, 2006, p. 5). This seemingly suggests that parts do not have a meaning if they are not part of the whole, and understanding cannot take place unless parts are integrated into the whole text (Kinsella, 2006). For this study, part and whole are contextualised as part=past views and whole=present views on mobile learning. This implies that pre-service teachers' preconceptions about mobile devices (past) could be shifted if they are encountered with mobile-mediated learning experiences (present). Therefore, I argue that for pre-service teachers (students) to understand and appreciate the potential of mobile devices in teaching and learning, it can only happen when their past experiences are integrated with their present experiences of mobile devices, which may guarantee the understanding of mobile learning.

About the above sentiments, this study aligned with Gadamer's perspective of hermeneutic experience as a learning experience. Gadamer identifies that when an individual undergoes a personal learning experience, it creates a radical shift in their consciousness and, after this transformation, they cannot return to the previous views held (McManus Holroyd, 2007). This process he refers to as a reversal in consciousness. This implies that the process of self-understanding is located within the temporal structure of an individual's lifeworld and moves in a metaphorical circle of experience, interpretation, and revision (Warnke, 1987, as cited in McManus Holroyd, 2007). In the context of this research, the shifting of pre-service teachers' disposition through mobile-mediated experiential learning (physical world) serves as evidence of reversing consciousness on mobile devices.

There are Gadamer's concepts and ways that allowed me to understand and respond to the research problem of this study, which is to develop an intervention of experiential mediated-mobile learning for pre-service teachers in Namibia. These are: fusion of

horizons, prejudice, dialogue, reversal in consciousness, and HLE (Clark, 2008). These concepts provided the language and philosophical underpinning for this study.

Fusion of Horizons

According to Gadamer, understanding is reached under which a fusion of horizons takes place (Kinsella, 2006). When we encounter the past, we can move from our current understanding or horizon to a new understanding or horizon (Clark, 2008). This, of course, means that the past is being used to bring meaning to the present. This also means that the present can only be understood in the context of the past. The fusion of horizons for this study will be achieved if the pre-service teachers are influenced to reflect and revisit their past experiences or understanding and align them with the present experience to create a new understanding of mobile devices as teaching and learning tools. Furthermore, Gadamer also argues that the meaning of the text must be found within its cultural, historical, and literacy context (Kinsella, 2006). In this light, recognising the influence of prejudice (preconceived ideas, biases, pre-conceptions, assumptions) conditioned by historical and traditional circumstances (such as cultures, languages, religions, places, etc.) must be considered as this can condition and limit understanding.

Prejudice

Gadamer suggests that "we can become conscious of our own prejudices only when we encounter a text whose meaning challenges the truth of our own prejudices"(Jacobs, 2014, p. 302). For instance, pre-service teachers (students) may have already decided that a mobile device is a tool for social use (prejudice) (see chapter 5, how pre-service teachers use their mobile devices), which means that their pre-understanding can influence their judgment on what mobile devices can offer. This suggests that fusion of horizons requires an awareness of students' pre-conceived views about mobile learning. To come into prejudice, it is important that the researcher addresses the issues of foreknowledge and prior experiences (Geanellos, 2000) on mobile learning, which can be done through text, conversations, and practices to challenge their prejudice about mobile devices. Consistent with Gadamer's views, the significance of this process creates students' awareness of their own historical consciousness through reflection, and, subsequently, they will shift their prejudice to an authentic understanding of mobile devices as teaching and learning tools. As a result, I contend that unless pre-service teachers' (students') prejudices are reversed and addressed,

they will be unable to gain a broad and positive understanding of the potential of mobile devices in the process of teaching and learning with technologies.

Dialogue

Having made the case for an ontological account of understanding, Gadamer also argues that understanding involves a fusion of horizons that occurs in a process of dialogue (Shapcott, 2011). Having made the case for an ontological account of understanding, Gadamer also argues that understanding involves a fusion of horizons that occurs in a process of dialogue (Jacobs, 2014), For instance, there is a need to explore students' experiences through conversations within oneself, text (students' artefacts), artworks, and those of others to encounter a new experience on mobile devices. In a conversation, students engaged in a dialogue to reflect on their past and what they are currently experiencing, with the expectation of making sense of each other to capture or create new meanings and understanding.

It is worth noting that to achieve the goal, students must be open and willing to use an advanced and transformed mode of learning that incorporates the use of mobile devices. The position I develop here as suggested by Gadamer is that the 'fusion of horizons' can be interpreted as a metaphor for the teaching process; a simple reflection of what happens in a classroom (mobile-mediated learning experiences), with an educator (facilitator) and the students interacting, thereby resulting in change in dispositions.

Hermeneutic Learning Experience (HLE)

Gadamer's point of view on HLE theory is viewed in relation to the development of students' reflective skills in mobile learning. In this study, reflection is defined as "intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understanding and appreciation" (Boud et al., 1985, as cited in Herrington et al., 2014, p. 24). Action learning (AL), a pedagogical theory of this study that can guide to focus and provide direction for real-life practices and learning through observation (James, 2018), can facilitate reflection. Based on this point of view, reversal of conciseness and fusion of horizons, as suggested by Gadamer, can be constructed through the process of reflection, which can be facilitated by experiential learning.

According to Gadamer, learning experience serves to revise the way in which we understand our past and this is interwoven with our present to anticipate the future (McManus Holroyd, 2007). Therefore, in the context of this study, I argued that pre-service teachers' consciousness to transformative learning has the potential to be achieved through experiential action learning. To a certain extent, this can happen if students are partaking in a dialogue (connecting the past to the present), giving them an opportunity to recap and reflect on their prejudice (a perception that is bound to be inspired and undergo transformation), which might shift their disposition towards mobile devices. This suggests that if students are encountered through experiential mediated learning on the effective use of mobile learning as a teaching method, then the impact on their disposition, which is the impact on their consciousness, can be achieved. For this reason, action learning, which involves authentic tasks, reflection in-action and on-action (see Coulson & Harvey, 2013), various dialogues, testing, cycles, and iterations on mobile-mediated learning was adopted as a pedagogical framework and approach for this study.

6.4 Action Learning (AL) Theory

Action Learning (AL) is a pedagogical framework that is used to understand the design principles for developing mobile-mediated experiential learning interventions for pre-service teachers. AL is a learning approach that was developed by Revans (1980) as a work-based, problem-solving technique to initiate change through reflection and questioning of current experiences (James, 2018). It combines "learning-by-doing with reflective learning and collaboration" (Ferguson et al., 2019, p. 27), which has "similarity with the experiential learning and reflective practice approach" (James, 2018, p. 876).

Gadamer's HLE theory assists in framing the AL process to provide experiential learning for pre-service teachers to enable them to employ M-learning in a purposeful and reflective way. This implies that reversal of consciousness towards mobile devices can be acquired through reflective questioning, dialogue, and by doing real tasks within the actual situation, and here the two theories (HLE and AL) were blended together to formulate the design principles that guided the M-MLIs among the pre-service teachers. This concurs with Passey (2020) who suggests that a single or multi-theory approach provides the underpinning and conceptual basis of the study or main elements of it. Hence, multiple theories were relevant as AL allowed pre-service teachers to create and redefine students' frame of reference (mental models) where they were given the

opportunity to re-visit their past experiences with mobile devices to make sense of their present situations (as Gadamer postulated), which is mobile learning (see Yeo & Gold, 2011).

Revan (1998, 93) claims that there is no learning without action and no action without learning (Huh & Lee, 2015; McLoughlin, 2004; Yeo & Gold, 2011). This means that pre-service teachers might not see the relevance of mobile learning if they did not learn something from their actions. Therefore, AL allowed me to create the experiential mobile-mediated learning among pre-service teachers for this study. By doing this, I responded to Gadamer's theory of HLE and used reflection on-action and in-action to develop pedagogical experiences of M-learning.

AL consists of four main components: (a) *A coach* (researcher), (b) a *group* (a small group of 4-8 students), (c) a *problem* (from students' physical world) and (d) *questions* (dialogue) (Ferguson et al., 2019). See Figure 6.2 below:

Figure 6.2

Components of Action Learning Theory

Note: This figure shows the four main components of using action learning theory that can be used to develop a pedagogical experience of Mobile-learning. From "Innovating Pedagogy" by R. Ferguson, T. Coughlan, K. Egelandsdal, M. Gaved, C. Herodotou, G. Hillaire, and D. Whitelock, Open University Innovation Report 7. https://iet.open.ac.uk/file/innovating-pedagogy-20. CC-BY 2.0.

For this study, I used the theoretical framework of action learning (authentic learning context) with the support of the Triadic Zone of Proximal development framework (to address the notion of learning technologies in a resource constrained environment) and HLE theory. The following section presents how the conceptual framework of this study was framed.

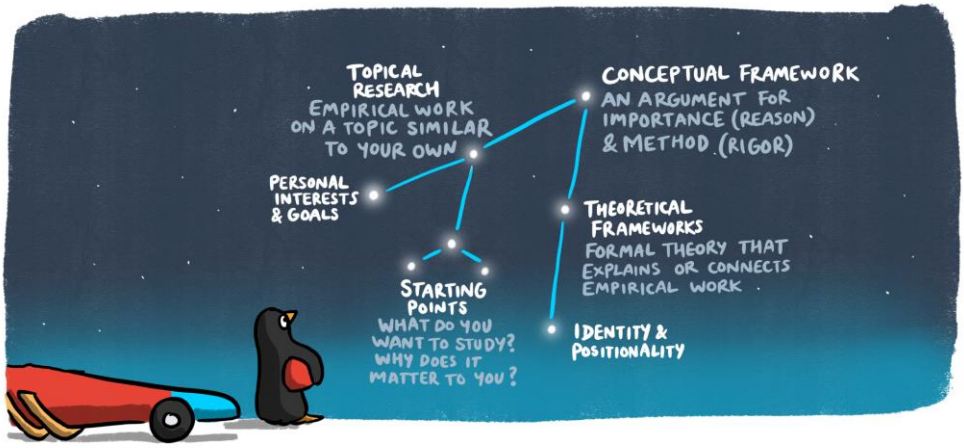
6.5 Conceptual Framework for the Study

A conceptual framework "brings together a set of ideas and articulates the different concepts that will be used in a study or research project" (Farrow et al., 2021, p. 6). Farrow et al. (2021) ascertain that the process of research is more persistent and holistic when an operative conceptual framework is in place. They suggest that a conceptual framework can include components like (see Figure 6.3):

- Modelling relationships between theories
- Reducing theoretical data into statements or models
- Explicating theories that influence the research
- Providing theoretical bases to design, or interpret, research
- Creating theoretical links between extant research, current theories
- research design, interpretations of findings and conceptual conclusions

Figure 6.3

Elements of a Conceptual Framework



Note: This figure shows the elements of conceptual framework that ascertain the research process of the study. From *GO-GN Guide to Conceptual Frameworks by R.* Farrow, F.Iniesto, M. Weller, R. Pitt, A. Algers, M. Baas, and G. Witthaus, 2021, p. 12. CC-BY-4.

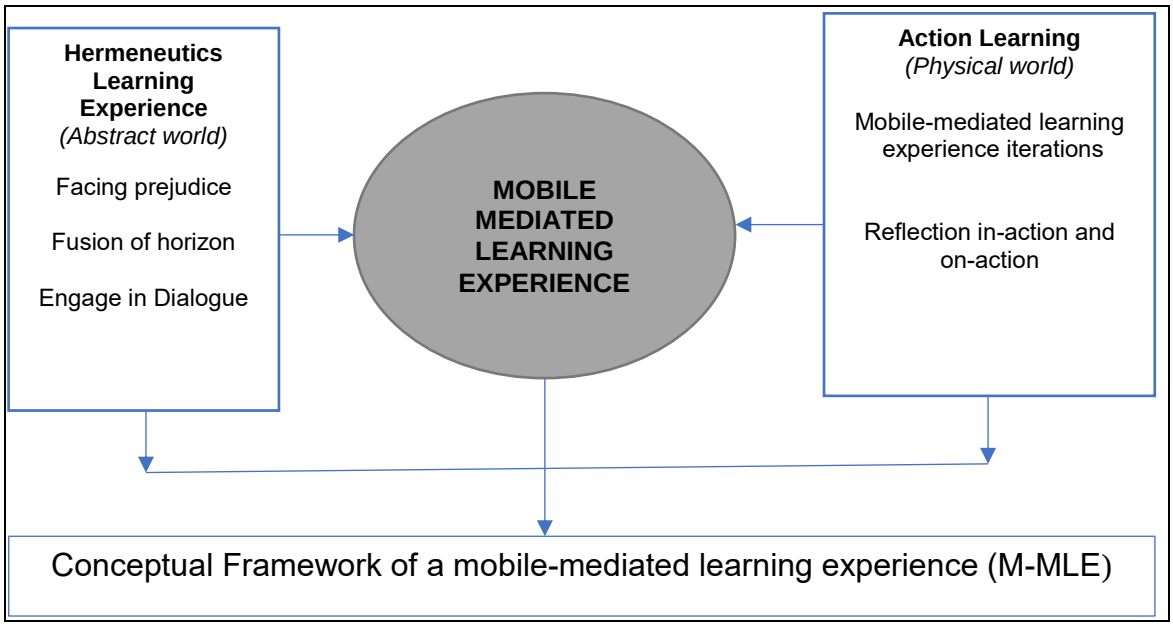
The conceptual framework for the study is developed from the Gadamerian theory of Hermeneutic Learning Experience (HLE) (see McManus Holroyd, 2007) and Revans's (1980) Action Learning (AL) theory (see Ferguson et al., 2019) as depicted in Figure 6.4.

Figure 6.4 illustrates how the two theories were used to develop mobile-mediated learning experiences among the pre-service teachers. The HLE theory represents the *abstract world* of the study, while the AL theory represents the *physical (practical) world*.

The *abstract* world depicts how hermeneutic concepts connect empirical work and manifest in the physical world as an intervention in this study. It illustrates the actual practices of learning experiences that allow pre-service teachers' mental consciousness to play out. It also addresses the research questions 1 and 2 of the study (see Chapter One), which aimed at understanding how hermeneutic mobile-mediated learning experiences diffuse horizons to shift dispositions, which becomes the evidence of a reversal of consciousness among pre-service teachers.

Figure 6.4

Conceptual Framework of the Study



The *physical* world (AL) illustrates the way in which the practical aspect of the implementation of the design solution developed for the study was enacted. This was accessed via dialogue (within oneself and others), coaching, reflection in-action, and on-action during the mobile-mediated learning iterations. At this point, mobile-mediated action learning experiences played out in the physical world, and the pre-service teacher may see the potential of mobile devices in the real world. Also, their disposition towards mobile devices is likely to shift. This represents how mobile-mediated learning pedagogical experiences transform the understanding of pre-service teachers towards mobile devices as teaching and learning tools, which is the objective of this study. To

this end, research questions 2 and 4 of this study (see Chapter One) were addressed here.

6.6 Chapter Summary

This chapter presented the theoretical and conceptual framework of this study. The theories of AL and HLE were discussed in detail. From the two theories, DBR was positioned into the conceptual framework of the study, which demonstrates the way the theoretical concept played out in the physical world (practical) as well as in an abstract world (theoretical) for this study. The next chapter (seven) presents how the existing design guidelines from the literature review and theoretical framework informed the construction of the design guidelines to address the research problem of this study.

CHAPTER 7: THE CONSTRUCTION OF DESIGN PRINCIPLES OF THE MOBILE-MEDIATED LEARNING INTERVENTION (M-MLI) *(DBR PHASE TWO)*

7.1 Chapter Overview

Consistent with DBR phases, Phase Two of design research for this study was to develop a robust intervention or solution informed by existing models and technological innovation in the educational setting. This chapter presents how the existing design guidelines from the literature informed the construction of the design solution to address the research problem. The elements of authentic learning, the Zone of Proximal Development (ZPD), Personal Learning Environment (PLE), and Kirkpatrick's evaluation model are used to design a learning solution that guides the mobile mediated-learning intervention that is meaningful and relevant for this study.

7.2 Development of mobile-mediated learning intervention

In order to create a solution, the researcher must consult literature to find relevant theories that can guide thinking as well as locate the existing design guidelines that may have addressed a similar problem (Herrington et al., 2010). The critical aspects from previous researchers, literature and the fact-findings study results (analysis of practical problems in collaboration with other practitioners' phase One of DBR, see Chapter six) suggest that the concept of situated learning, learning through real-life settings, learning by doing and learning by experience can be an effective pedagogical approach for delivering an e-learning course.

A design solution to address the identified problem for this study that guided the M-MLI for pre-service teachers is informed by the existing design framework of authentic learning by Herrington and Oliver (2000) linked with theory of AL and HLE. I adapted Jan Herrington's authentic learning elements that emerged from the literature (see Chapter Three, literature review on emerging technology) as the design guidelines to address the research problem. The authentic learning or authentic e-learning elements comprises of nine guiding principles (Herrington & Oliver, 2000; Herrington et al., 2014; Herrington et al., 2010), out of nine authentic learning guiding principles, this study chose only five guiding principles which were deemed relevant for this study (see Table 7.1).

7.3 Elements of authentic learning guiding principles

The nine elements of authentic learning based on situated learning theory are listed below (Herrington & Oliver, 2000):

- Provide *authentic contexts* that reflect the way the knowledge will be used in real life.
- Provide authentic activities.
- Provide access to *expert performances* and the modelling of processes.
- Provide multiple roles and perspectives
- Support collaborative construction of knowledge.
- Promote *reflection* to enable abstractions to be formed.
- Promote *articulation* to enable tacit knowledge to be made explicit.
- Provide *coaching* and *scaffolding* by the teacher at critical times.
- Provide for *authentic assessment* of learning within the tasks (p. 25).

Although the researchers and literature on situated learning proposed nine elements of authentic learning, this study adopted only five elements that are highlighted in light grey as shown above. Ideally, *an authentic learning environment "requires students to complete a single realistic and complex task encompassing the entire curriculum, with all assessable components contributing to that one endeavor"* (Herrington et al., 2014, p. 25). In this way, it is important to describe how each of the selected elements was instantiated in the mobile-mediated learning setting. The five selected elements of authentic e-learning for this study are described in detail below (modified from Herrington & Oliver, 2000):

Authentic context: the first crucial setting of an authentic learning environment is to create an authentic context that reflects the way the knowledge would be ultimately used in real life. For this study, a mobile-mediated learning experience context was created for pre-service teachers to simulate how mobile devices would be used in a real-life classroom setting and their school subject specializations.

Authentic tasks: The authentic task cannot be achieved without providing ill-defined activities with real-world relevance, allowing students to define their own tasks. By designing authentic tasks for a mobile-mediated learning experience, appropriate mobile learning technological tools were selected, Padlet, Zoom, Google Docs,

WhatsApp etc. Pre-service teachers were given complex tasks and activities to practice mobile-mediated learning over a certain period.

Multiple roles and perspectives: instead of being exposed to a single perspective to examine a problem that is deemed to be inadequate, it was important to enable and encourage pre-service teachers to explore different perspectives on the different topics and subject areas to "crisscross" the learning environment repeatedly. At this point, pre-service teachers were engaged in different tasks and activities to explore the topic from different points of view, such as accessing Online Educational Resources (OER), developing mobile mediated learning lessons, developing educational websites, designing teaching material for a mobile mediated learning context, pre-recorded online videocast, navigating features and affordances of the educational tool, posting video links on a Padlet wall, listening to each other videos, etc.

Collaboration construction of knowledge: proving an opportunity to collaboratively construct knowledge are important elements of an authentic e-learning context. Here, tasks are to be completed in pairs or groups rather than an individual so that they can work together to complete a task or solve a problem. The collaborative construction of a mobile mediated learning experience was encouraged by allocating certain tasks in pairs or groups such as pre-service teachers post comments on each other's post on a Padlet wall, work as a team to develop a mobile mediated learning experiences questionnaires as well as comment and complete on each other's questionnaires etc.

Reflection: Boud, Keogh and Walker (1985) (cited in Herrington et al., 2014) define the process of reflection as principally comprising three closely related stages:

> R*eturning to the experience (recollecting the salient features of the experience, recounting them to others); attending to feelings (accommodating positive and negative feelings about the experience) and re-evaluating the experience (associating new knowledge, integrating new knowledge into the learner's conceptual framework) (p. 25).*

Mobile learning enables the conditions for authentic learning to be achieved, "allowing learning tasks designed around content creation, data capture, location-awareness; and collaborative working in real-world settings" (Kukulska-Hulme & Traxler, 2020, p. 186).

Providing opportunities for pre-service teachers to reflect on their mobile mediated learning experiences, non-linear navigation authentic activities were provided to enable

them to reflect and explore their learning experiences to lead to a new understanding and appreciation of mobile learning. This was done by providing effective activities such as completing a pre-and post-evaluation questionnaire, posting their new acquired skills and knowledge on the “progress report journal” for each session and creating a reflective questionnaire at the end of the intervention. In this way, pre-service teachers reflected in-action through decision-making on resource collaboration and development as well as reflected on-action as they kept their posts.

The development of the design solution was advanced by the framework of the Triadic Zone of Proximal Development (see Eun, 2019; Ng'ambi & Bozalek, 2016); the design of the Personal Learning Environment (PLE) (Korhonen et al., 2019; Martindale & Dowdy, 2016); and the Kirkpatrick evaluation model (Alsalamah & Callinan, 2021; Praslova, 2010) with the aim of developing a mobile mediated learning intervention that is meaningful and relevant for the study. These frameworks are discussed as follows:

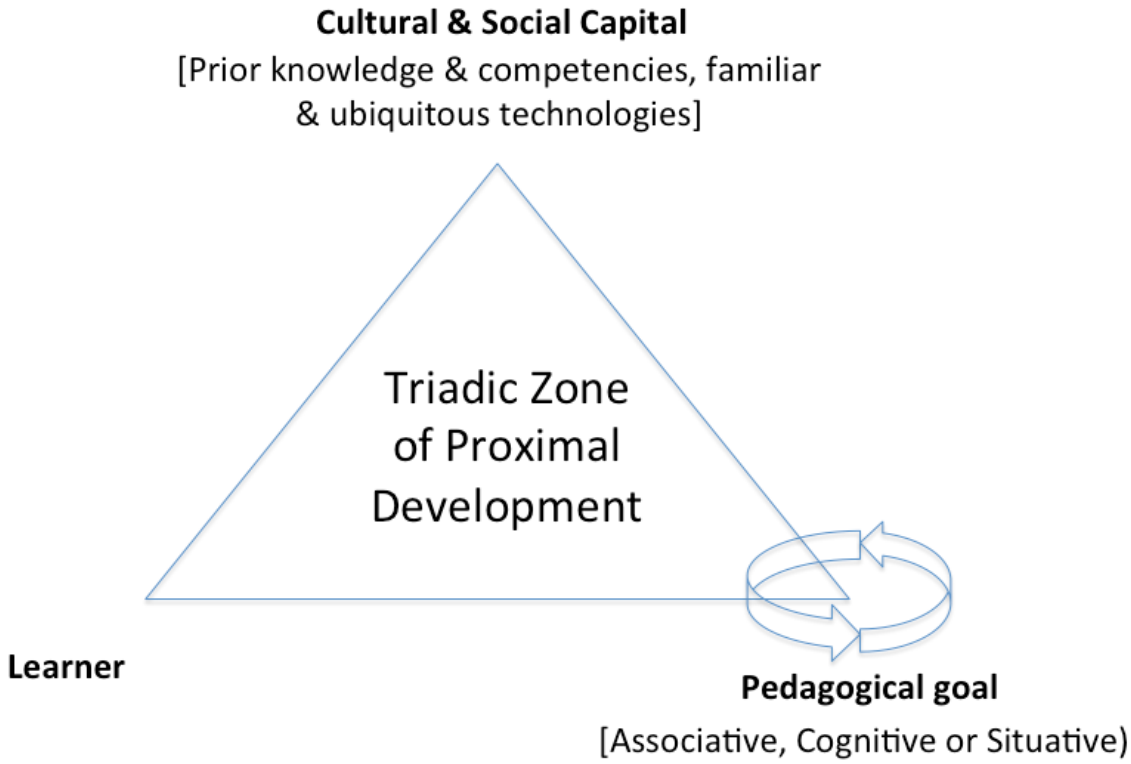
7.4 Adaptation of a Triadic Zone of Proximal Development (ZPD) to M-MLI

The zone of proximal development (ZPD) is defined as "an overarching concept that integrates the main tenets of Vygotsky’s theory of human development.”The conceptualization of the ZPD begins with its social, cultural, and historical context and traces its development as a spatial and temporal metaphor that reflects the sociogenetic root of all human mental functioning" (Eun, 2019, p. 18). ZPD can also be defined as "the difference between what one could do alone and what one could do with assistance" (Russell, 2002, p. 73). Such assistance can be from lecturers, teachers, parents or others. Ng’ambi and Bozalek (2016) theorized and proposed how Triadic ZPD can be applied in a resource-constrained environment which provides a way of appropriating the learning technologies that take cognizance of cultural, historical, and social capital of learners.

One of the challenges that the educators cautioned about during a fact-finding study (see Chapter Five) was that schools or learners from low-income backgrounds or resources-constrained environments might dictate the extent to which technologies or mobile learning are appropriately used to enhance teaching and learning (see Ng'ambi & Bozalek, 2016). The proposed Triadic ZPD framework by Ng’ambi and Bozalek (2016) for learning technologies in resource-constrained environments is presented in figure 7.1 below.

Figure 7.1

Triadic ZPD for learning technologies in resource-constrained environments



Note: This figure depicts the proposed Triadic ZPD framework for learning technologies in resource-constrained environments. From Technology enhanced teaching and learning in South African higher education – A review of a 20-year journey by D. Ng'ambi, C. Brown, V. Bozalek, D. Gachago, and D. Wood, 2016, British Journal of Educational Technology. Copyright 2016 by British Journal of Educational Technology

I infer to Ng'ambi and Bozalek that it is important to be sensitive to learners' prior competences and knowledge (for this study, the use of mobile phones as a teaching and learning tool among pre-service teachers) and that marginalization of knowledge is a recipe for failed interventions. For instance, a fact-finding study (Chapter Five) shows that IUM pre-service teachers are normal users of mobile phones; that they use them for social interactions, searching, and sharing of educational resources but are not seen as a tool for teaching and learning. Hence, this study put into cognizance the cultural, social capital, pedagogical goal, and tool to be used for each mobile-mediated learning session, and they were appropriately matched with each other (see Table 7.1).

Table 7.1

Formulate drafted design guideline aligned with Triadic ZPD framework and Hermeneutic Learning Experience

Learning practice	*Mobile-Mediating Learning Intervention*		
Design Guidelines (elements of authentic learning)	**Triadic Zone of Proximal Development (ZPD)**		**Hermeneutic learning experience**
	Context	***Technology***	
Provide authentic context that reflects the way the knowledge will be used in real-life	*Social/cultural Setting:* Third-year students in a teaching methods class: two (Commerce); two (Natural Sciences); two (Languages); two (Social Sciences)	*Tool:* Padlet wall: https://padlet.com/a_ndeunyema/ll9qk0dawphh6793; Mobile devices	Setting up of experiential learning; Addressing prejudice and bias Mobile mediated action learning
	Pedagogical goal: Check understanding, Create the environment for student self-reflection, create a real-world mobile mediated task in their specialized subjects through Padlet (Associative view)	*Process:* (F2F Physically Distanced setting) Create a WhatApp group for information sharing and Invite students to an introductory session on mobile-mediated learning using F2F physically distanced environment Students download and install a Padlet App on their mobile devices and complete a consent form and a pre-evaluation questionnaire on google form, a link posted on a Padlet wall Invite students to an exploratory fun activity on the Padlet by introducing themselves indicating their names, subject majors, their previous mobile learning	

			experiences Invite students to complete a (progress report chart) for Session One a link posted on a Padlet Wall	
Provide authentic tasks		*Social/cultural Setting*: Third-year students are already users of mobile devices for learning. They are regular users of: WhatsApp, Moodle (LMS), Zoom, YouTube, Google suite, Google meet	*Tool:* Padlet wall: https://padlet.com/a_ndeunyema/ll9qk0dawphh6793; Google search engine; YouTube; OER web page; Flickr	Past meets the present Shift in disposition Reversal of consciousness Whole = present Mobile mediated experiential learning
		Pedagogical goal: Engage content learning + support communication skills development; Enable students to define the subject tasks and sub-tasks to complete authentic activities including: five engagement sessions, commenting on peers' posts, knowledge sharing with both researcher (educator) and peers, engaging with supplementary web-based Applications/Resources (Situated view)	*Process* (F2F Physically distanced setting): Students access a pre-mobile mediated task: to identify a topic from their specialized subject syllabus and one learning outcome. Students search for suitable/relevant teaching resources for the chosen topic using a google search engine, YouTube; Flickr and OER web pages and post them on the wall	
Provide multiple roles and perspectives		*Social/cultural Setting:* Third-year students own smartphones/laptops/iPads, use them to develop and complete mobile mediated authentic activities using different tools and platforms	*Tool:* Padlet wall: https://padlet.com/a_ndeunyema/ll9qk0dawphh6793; Google search engine; YouTube; PowerPoint; Zoom/ Screen Recorder & Video Recorder- XRecorder App, WhatsApp	Mobile mediated learning wrapped in reflection Fusion of Horizons

		Pedagogical goal: Engage + check understanding; Provide opportunities for students to examine tasks from different perspective, using a variety of resources and platforms Enable students to Integrate and apply authentic tasks in their different subject specialization, diversify students' perspectives through interactions with peers, researcher (educator), online educational materials, chats, etc. (Situated view)	*Process* (online asynchronous setting): A mobile mediated task with multiple roles is assigned: Students work in pairs/ individual and use the teaching materials they posted on the Padlet wall in Session Two to develop a PPT, Create teaching content for mobile device, Develop and construct a videocast using XRecoder/Zoom, Create a YouTube channel, Post their videocast to their YouTube channel, Subscribe to each other's channels, Share their online lesson video YouTube links to the Padlet wall	
Support collaborative construction of knowledge		*Social/cultural Setting:* Third year students are users of their mobile devices to complete an online research questionnaire and instant messaging and forum discussion such as WhatsApp, Emails, LMS	*Tool:* Padlet wall: https://padlet.com/a_ndeunyema/ll9qk0dawphh6793; Google form; YouTube;	Fusion of horizon occurs in the process of. Dialogue
		Pedagogical goal: Strengthen understanding; provide students with the opportunity to collaborate through practical subject problem solving and creating teaching resources to strengthen students' understanding and soliciting of peer guidance to complete tasks (Cognitive view)	Process: (online asynchronous setting) Develop an online questionnaire using Google form Develop a five questions questionnaire consisted of one multiple choices, one linear scale, one checkbox, one short question and one multiple choice grid question	

			The questions should be about the mobile learning experiences from the past three sessions by asking peers about their Padlet experiences. Post questionnaire links to the Padlet for others to access and complete or comments on how to improve each other's questionnaires	
Promote reflection to enable abstraction to be formed		*Social/cultural Setting:* Third year students draw on their mobile mediated experiential learning for reflection, they are users of google docs	*Tool:* Padlet wall: https://padlet.com/a_ndeunyema/ll9qk0dawphh6793; Google form; Zoom	Reflection on-action and in-action Fusion of Horizons Shift in disposition Hermeneutic learning experience
		Pedagogical goal: Reflect on learning + planning for future learning connections: Provide opportunities for reflection on action and in-action. Such as getting feedback from students by posting on Progress Report Chat (PRC) every end of the session and develop a post-evaluation questionnaire for students after the intervention (Cognitive view)	*Process* (online synchronous and asynchronous setting): Students complete a post mobile mediated learning evaluation questionnaire posted on a Padlet wall Post a question on a Padlet wall for students to present their mobile mediated learning experience/reflection, limitations (using their "progress report chat" from google drive), plan for future use via Zoom and screen share	

Table 7.1 presents an overview of the design guidelines formulated for the mobile-mediated learning intervention. These guidelines integrate authentic elements, aligning them with the triadic ZPD framework and hermeneutic learning experience. The table showcases how the concept of ZPD was effectively applied in the intervention,

considering the participants' specific environmental learning context. Additionally, it highlights the deliberate use of various technological tools and processes to facilitate the learning experience. The table provides a comprehensive understanding of the strategies employed to create an engaging and impactful mobile learning environment, ensuring optimal learning outcomes for the participants. It serves as a valuable resource for educators and researchers seeking to design similar interventions and leverage mobile technologies for effective teaching.

7.5 Designing of a Personal Learning Environment (PLE) for M-MLI

Following the design guidelines of authentic learning and the framing of a resources-constrained environment using the Triadic ZPD framework for a mobile mediated learning intervention (as summarized in Table 7.1), it was also pertinent to design a pedagogical learning model that supports the authentic, dialogical, and collaborative learning environment for this study.

A learning design is defined as "an individual example of a sequence of teaching and learning activities, also called a "design" or "sequence". A learning design is a plan for potential activities with learners, which is to be distinguished from a particular implementation of this plan with a particular group of learners (Cronje, 2016, p. 134). For instance, students may be asked to make blogs to help them reflect after a mobile mediated learning session and even comment on one another’s blogs. The design of a learning environment for this study was created according to the researchers and educators who proposed the need for suitable mechanisms of modern features on how to design a given personal learning environment to expect positive effects on students’ learning (Ivanova & Chatti, 2011).

There are several authors that attest to the design of Personal Learning Environments (PLEs), especially to be created and adopted by Higher Education (Casquero et al., 2016; Ivanova & Chatti, 2011; Korhonen et al., 2019; Martindale & Dowdy, 2016; Simões et al., 2013). PLE enables students to assemble their own set of tools and resources for self-regulated learning (Cronje, 2016). Its functions are based on “social software tools and services which allow students to interact and share content and knowledge with other peers and professionals. Blogs, wikis, newsreaders, social networking websites, and social bookmarking sites are examples of some of the tools that are being used to share and collaborate in educational, social, and personal

contexts" (Ivanova & Chatti, 2011, p. 420). Personal Learning Environments (PLEs) are defined as:

> *Systems that help learners take control of and manage their own learning. This includes providing support for learners to set their own learning goals; manage their learning… both content and process; communicate with others in the process of learning, and thereby achieve learning goals. A PLE may be composed of one or more subsystems: As such it may be a desktop application, or composed of one or more web-based services (Martindale & Dowdy, 2016, p. 120).*

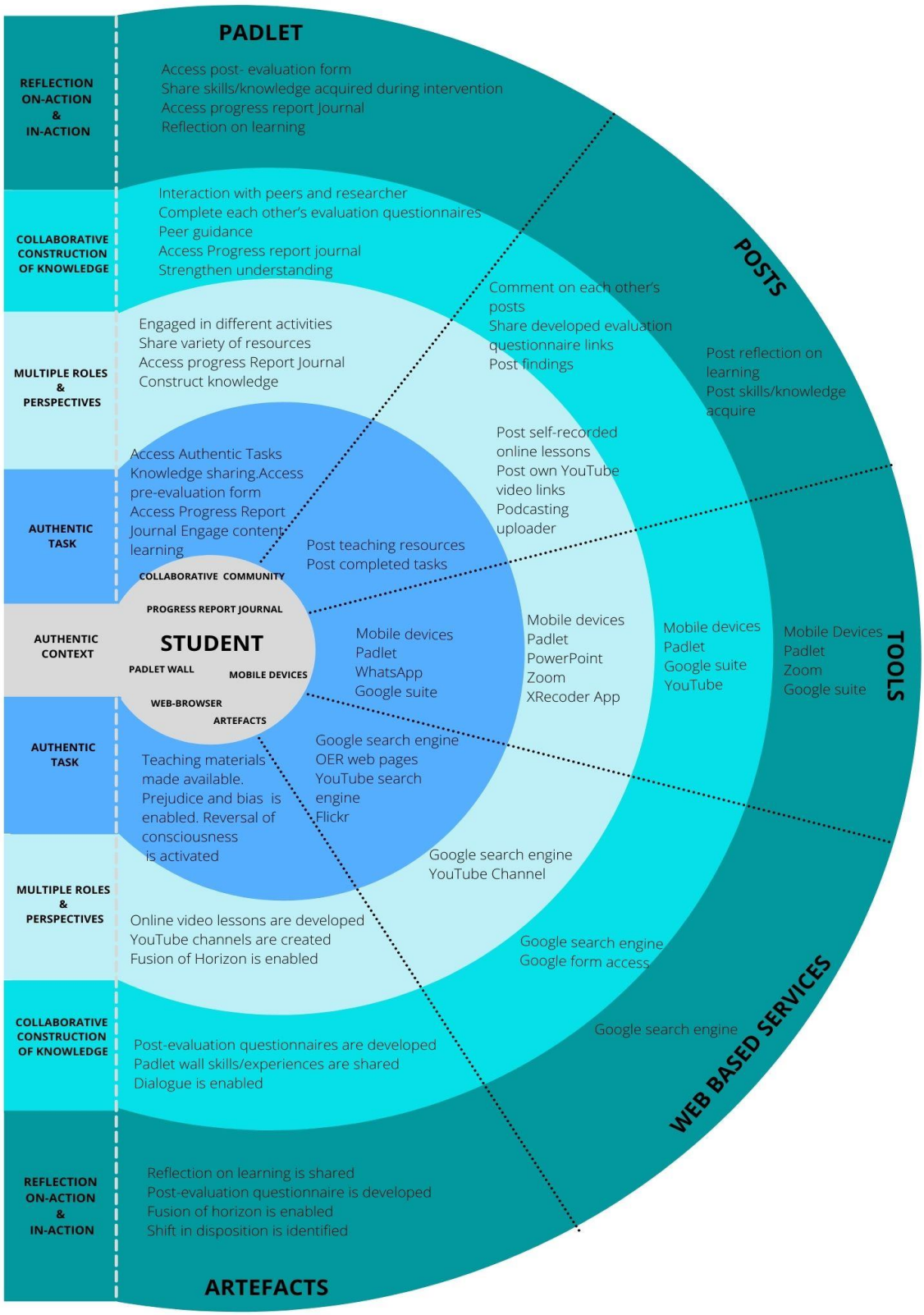
The characteristics of the PLE design may be achieved using a combination of existing devices (laptops, mobile phones, portable media devices), applications (newsreaders, instant messaging clients, browsers, calendars) and services (social bookmark services, weblogs, wikis) (Martindale & Dowdy, 2016), Blogger, digital resource repositories, Delicious, Flickr, YouTube, Scribd, and SlideShare (Casquero et al., 2016) within what may be thought of as the practice of personal learning environment using mobile technologies. For the learning design of this study, I developed a Personal Learning Environment (PLE) model of a M-MLI (see Figure 7.2) modified from Scott Leslie's PLE Diagram (found in Martindale & Dowdy, 2016) to obtain a better understanding regarding the social interaction they enabled during the intervention (Casquero et al., 2016).

As Padlet was an innovative mobile application chosen for this study, other web tools that were used to design the mobile personal learning were Web-browsers, Google Applications, WhatsApp, YouTube, Zoom, Open Resource Repositories, Flickr and other tools pre-service teachers personally considered to be relevant for their mobile-mediated learning experiences. Students use such tools and a system to mirror the conventional learning environment, to reflect, to showcase their skills, and to network and communicate (Cronje, 2016).

Figure 7.2 showcases the PLE implemented in this study, providing a visual representation of the utilization of a Padlet as a tool for teaching and learning. It depicts the specific tasks undertaken by the participants, as well as the various technological tools, applications, or websites incorporated in the learning process.

Figure 7.2

Personal Learning Environment (PLE) framework of a M-MLI for the study



The figure also highlights the artifacts produced by the participants because of their engagement with the PLE. Additionally, it demonstrates the seamless integration of the design guidelines of authentic learning throughout the mobile-mediated learning intervention, ensuring a cohesive and effective learning experience. The figure offers a comprehensive overview of the PLE setup, illustrating the rich interaction and engagement facilitated by the combination of Padlet and other technological resources.

7.6 Adaptation of Kirkpatrick's Evaluation Model to a M-MLI

The design guideline and technological innovation for this study define the tasks and activities that pre-service teachers performed during the M-MLI (see Figure 7.2). For an intervention, it is necessary to "perform a monitoring and evaluation plan which measures the fidelity of implementation and determines if the pedagogical model was adopted, using process and result indicators" (Rodríguez et al., 2012, p. 84). One of the models most frequently used to evaluate educational programmes is the use of four levels of Kirkpatrick's evaluation model (Alsalamah & Callinan, 2021; Kirkpatrick & Kirkpatrick, 2019; Praslova, 2010). The Kirkpatrick model has been successfully used for evaluation in many different training and educational settings (Alsalamah & Callinan, 2021). The New World Kirkpatrick Model shows how to create an effective training evaluation plan for any programme and be able to show the organizational value of the work (Kirkpatrick & Kirkpatrick, 2019).

Therefore, adaptation of Kirkpatrick's evaluation model to a M-MLI was deemed suitable for this study, with the aim of evaluating the process of the authentic tasks and providing opportunities for participants to reflect in-action and on-action. The usefulness of Kirkpatrick's evaluation model for aligning mobile mediated learning experiences' evaluation criteria and indicators is illustrated in figures 7.3 and table 7.2, respectively. The four levels of evaluation in Kirkpatrick's model are described as follows: *Level 1 is for reaction, Level 2 is for learning, Level 3 is for behavior, and Level 4 is for results (Kirkpatrick & Kirkpatrick, 2019).*

***Level 1 Reaction*:** The degree to which participants reacted to the application of what they learned during training when they are back on the job. For instance, measures how pre-service teachers react to the M-MLIs, e.g., were they happy, did they enjoy it, etc.?

***Level 2 Learning*:** Did the participants acquire the intended knowledge, skills, attitude, confidence, and commitment based on their participation during the training? For instance, analyzing if pre-service teachers acquired and constructed new knowledge during the M-MLIs, e.g., an increase in knowledge, skills, experience, or attitudes?

Level 3 Behavior: The degree to which participants find the training favorable, engaging, and relevant to their jobs. For instance, looking at if pre-service teachers will utilize what they learned during training in their future teaching practice (e.g., change in behaviors)

Level 4 Results: The degree to which targeted outcomes occur because of the training and the support and accountability package. For instance, how will we determine if the intervention will have a positive impact on the transformation of teaching and learning using mobile technologies in Namibia?

Figure 7.3

Adapting Kirkpatrick's model of evaluating a mobile mediated learning intervention

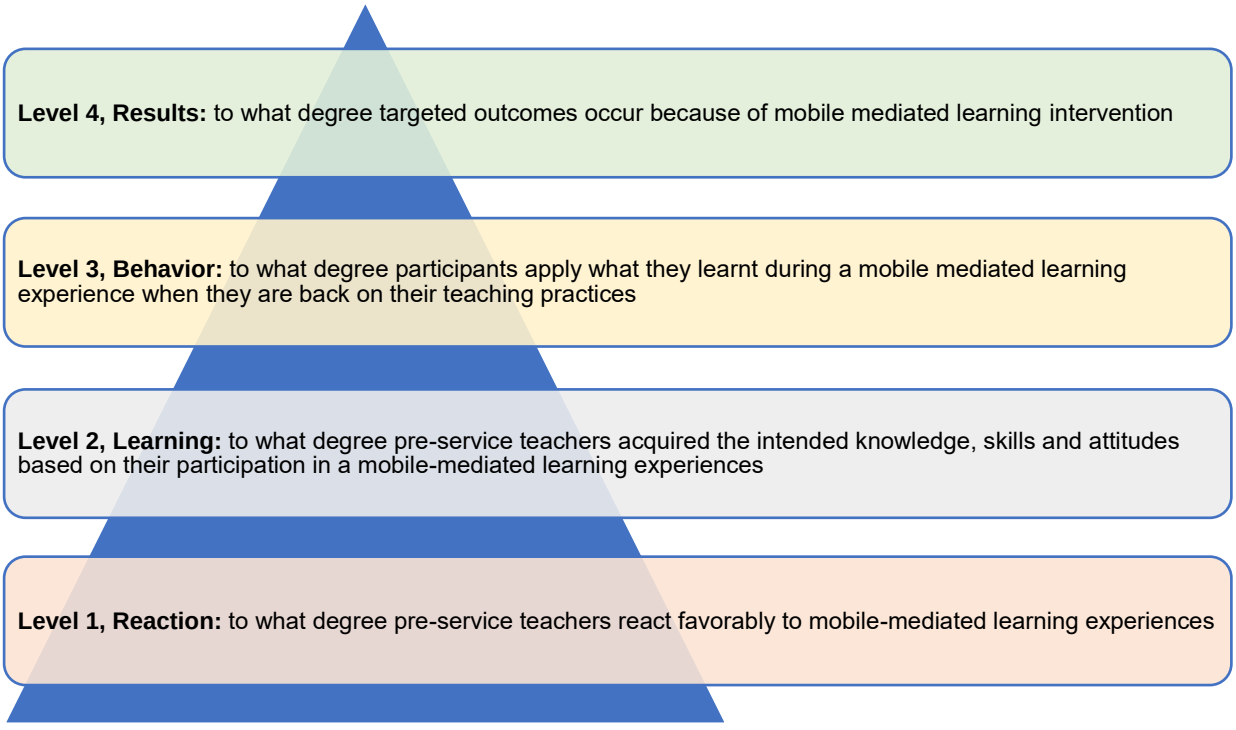


Table 7.3 I illustrated how each level of Kirkpatrick evaluation can be used to evaluate the M-MLI. While figure 7.2, shows clarification of the implementation of evaluation criteria through adaptation of four levels of Kirkpatrick model to M-MLI. However, for this

study, I only adapted the first two level of Kirkpatrick model to evaluate the M-MLI during Phase Three (DBR) of testing and refinement of solution for each cycle. This was deemed necessary with the aim of evaluating the process of authentic tasks and provides opportunities for participants to reflect in-action and on-action. This addresses Research Question 4 (RQ4, see Chapter One).

Table 7.2

The first two level of Kirkpatrick evaluation model for mobile-mediated learning

Level of Kirkpatrick	**Application/tool: How was this known?**
Level 1: Reaction To what degree pre-service teachers react favourably to the mobile-mediated learning experience? How did the mobile-mediated learning experience make them feel?	An online feedback/survey form/discussion forum is developed after completion of each iterative cycle *Questions asked:* What did you enjoy most about the mobile-mediated learning you experienced? What didn't you enjoy most about the mobile-mediated learning experience? Based on the way you felt doing this activity, would you recommend other students to apply this learning experience in their future teaching?
Level 2: Learning To what degree pre-service teachers acquired the intended knowledge, skills, and attitudes based on their participation in the mobile mediated learning experience? Did they learn how to use mobile devices to mediate learning?	Student artefacts/observation on a Padlet wall posts. *Questions asked on the Padlet wall:* Develop (an authentic task) a mobile mediated learning lesson for your subject that you will teach during your teaching practice List new skills/knowledge that you acquired during mobile mediated learning experiences? Complete a daily Progress Report journal (PRJ) via google Doc with students having a privilege to edit and share their experiences for each session.

7.7 Chapter Summary

This chapter described how literature was used to identify existing global design guidelines or design principles on how research problems like my study challenge were presented. Thus, the DBR notion of connecting existing draft design guidelines with theories of authentic learning (Miller, 2012) and hermeneutics was reflected by aligning with Triadic Zone of Proximal (ZPD), Personal Learning Environment (PLE),

Kirkpatrick's Evaluation Model Development. This combination resulted into formulated design guidelines that could be initially used to inform practice of the M-MLI for pre-service teachers. Subsequently, this chapter was critical in proposing the design of the M-MLI and formulated design guidelines applicable to the research of mobile learning. The proceeding chapters (Eight, Nine and Ten) presents DBR Phase Three reflected as iterative cycles of testing and refinement of solutions in practice (Reeves, 2006).

CHAPTER 8: IMPLEMENTATION OF THE ITERATIVE CYCLE OF MEDIATED-MOBILE LEARNING INTERVENTION (CYCLE ONE) *(DBR PHASE THREE)*

8.1 Chapter Overview

Continuing with DBR phases, Phase Three of this study is the implementation and evaluation of the proposed solution (developed in Chapter Seven) in practice. The first implementation was planned immediately after the construction of the design guidelines with an authentic e-learning context. Three iterative cycles were developed and implemented. All cycles were also planned as any research study: where choices of participants were done; procedural process of implementing and evaluating the intervention was done; data collection procedures to answer the research questions (RQ2, RQ3 and RQ4, see Chapter One); and finally, data analysis procedures. In this chapter, cycle one of the research iterative is presented.

8.2 Participants of mobile-mediated learning intervention (Cycle one)

Participants for this cycle were third year preservice teachers who were doing teaching methodology course were randomly and voluntarily selected to participate in this cycle. Selecting pre-service teachers in their third year for the iteration of mobile-mediated learning in a teaching methodology course aligns with their technological proficiency, professional growth needs, future classroom integration, convenience, and potential for increased engagement and motivation. They also had a foundation of knowledge and experience from their coursework and practical teaching experiences that they acquired from school base study. It is for this reason that introducing them to mobile learning strategies could contribute to their ongoing professional development, helping them become more versatile and adaptable educators in the digital age. Furthermore, as pre-service teachers progress through their education program, they were getting closer to becoming practicing teachers. It was essential at this stage of their study to prepare them for the realities of modern classrooms, which often involved the integration of technology. Therefore, by incorporating mobile learning into their teaching methodology course, they could explore ways to leverage mobile devices and applications to enhance their future teaching practices.

During the selection stage of participants for Cycle One of M-MLI, an invitation was sent to all the third year and fourth-year students (pre-service teachers) for the 2021 academic to participate in the research study via their class representatives. Students submitted their names and contact information to their class representatives and a list

was forwarded to the researcher. A total of 22 students submitted their names on the first day from different fields of school subject specializations. First, the researcher created a WhatsApp group and welcomed all the students (22) who submitted their names. Secondly, the researcher started posting chats, initiating conversations and monitoring how students were responding to the posts so that the researcher can identify who was active and who was not active.

The purpose of using this platform was three-fold: Firstly, a purposive sampling strategy was used to select the eight students who participated in Cycle One of the mobile-mediated intervention. Secondly, as an icebreaker to introduce students to a M-MLI; and thirdly, to find out whether students had access to the mobile technological tools. Because students indicated that they used WhatsApp on a regular basis (see Chapter Five, fact-finding study), WhatsApp was chosen as the primary mobile tool. At the end of two weeks, the researchers had selected four females and four males who were posting and responding to the messages in the group promptly as participants for Cycle One. The demographic details of participants for Cycle One of M-MLI are summarized in table 8.1 below.

Table 8.1

Cycle One summary of participants' background information

Student Code	Gender	Field of specialization & Year of study	Mobile device owned	Experience with Padlet before Yes/No	List of Application/website used before
ST1	F	Languages (Third Year)	Smartphone & Laptop	No	Google search engine and YouTube, WhatsApp
ST2	M	Languages (Fourth Year) (***Participant from phase one: fact-finding study***)	Tablet	No	WhatsApp, Telegram, Facebook, Google Meets, Zoom
ST3	F	Natural Sciences (Third Year)	Smartphone	No	Google search, Chrome, LinkedIn, YouTube, WhatsApp
ST4	M	Natural Sciences ***(Fourth Year, Participant from phase one: fact-***	Smartphone and Laptop	No	Google search engine, Chrome, LinkedIn, WhatsApp

		finding study)			
ST5	F	Commerce (Third Year)	Smartphone and Laptop	No	Google search and chrome, WhatsApp
ST6	F	Commerce (Third Year)	Smartphone	No	Google search and chrome, WhatsApp
ST7	M	Social Science (Third Year)	Smartphone	No	Google Search, Emails, Namibianhistory.co, WhatsApp
ST8	M	Commerce ***(Fourth year, Participant from phase one: fact-finding study)***	Smartphone	No	Chrome, blogs and ecommerce website, WhatsApp

Following Table 8.1, participants in the implementation of intervention Cycle One consisted of two (2) students from languages, two (2) from natural sciences, three (3) from commerce and one (1) from social sciences field of studies. All participants were pre-service teachers doing or did teaching methodology a third-year course module. Three participants were in their fourth year of study and they were part of a fact-finding study that was done when they were in their third year of study, while five participants were in their third year of studies and they were not part of the fact-finding study. One of the reasons to mix the third year and the fourth year students was that both students have done a teaching methodology course which aimed at acquiring pedagogical knowledge of their subject specialization (see Chapter Two).

A comparison between fourth year and third year students were also done on the basis that the fourth year students had done their teaching practice in schools for ten weeks as part of their internship while the third year students were at present doing teaching methods to prepare them for teaching practice. This also implies that obtaining participants reflection on their past teaching experiences (ten weeks teaching practice) with the present experiences of mobile-mediated learning, change in disposition toward mobile learning would be shifted. This also enabled the researcher to develop a clear understanding of how pre-service teachers' training (teaching methods) influenced their participation in a mobile-mediated learning activity and how it can be integrated into the teaching methodology curriculum.

Furthermore, the mobile devices owned by participants were as follows: seven (7) participants owned a mobile smartphone, one (1) owned a tablet, and three (3) owned both smartphones and laptops. All participants were frequent users of the Google search engine and WhatsApp instant messaging tool. Hence, the affordance of adapting a Padlet mobile learning technological tool. They all had no prior experience of a Padlet application. Thus, WhatsApp mediated interactions between student-student, student-peers, and lecturer-student/s during the intervention. WhatsApp did not substitute Padlet but served to post notifications, updates, and comments and whether there was a new post or changes made on a Padlet. On the other hand, WhatsApp was also used as a technique to connect past experiences of using mobile applications for learning to enable the deconstruction of knowledge (present experience) using Padlet Session One: Procedure of setting up an authentic e-learning context

According to the authentic learning elements, the first crucial consideration was to create an authentic context that reflects the way pre-service teachers will use mobile learning in a real-world setting (see, Herrington et al., 2010). For Cycle One, a real-world experience for mobile-mediated learning was created through a physically distanced (face-to-face) learning environment with participants wearing their masks at the time of the COVID-19 global pandemic.

Figure 8.1

Session One of M-MLI Cycle One

Note: Setup at the Postgraduate Seminar Room, Tunana Building -IUM for session one of M-MLI. Own work

An invitation to attend the first session of intervention was posted on the WhatsApp group and participants were advised to bring along their mobile devices (smartphones, laptops, and/or tablets/iPads). This session was held on May 19, 2021, from 15h00 to 17h00 at the Postgraduate Seminar Room, Tunana Building at IUM (Figure 8.1). The reason for a face-to-face session was to bring participants together and orient them to the Padlet Application, a mobile tool that they had no experience with. For internet access, the researcher provided two mobile (pocket) WiFi router[6] (top-up with data bundles) that were used for internet connection during the session.

The researcher created a Padlet wall for M-MLI Cycle One. I posted the welcoming and introductory remarks, a pre-evaluation form, as well as the PRJ links to the wall before the session. A trial run of Padlet was done in collaboration with the Dean of ICT, participants (pre-service teachers) and the researcher using mobile WiFi and mobile phones. At the beginning of Session One, an ice-breaking activity was given to the participants so that they could have an easy way to learn how to install and use a Padlet wall for teaching and learning using mobile devices.

After participants installed the Padlet App on their mobile devices, the researcher invited them to complete the activities that were posted on the wall. This was done to establish a meaningful and authentic context as well as to address the issues of foreknowledge, prejudice, and prior knowledge of mobile learning among the participants (see Table 8.2). Three IT practitioners were also present throughout the first session, focusing on assisting participants who were struggling with the installation of the Padlet App and internet connectivity, especially those who had phones which were not compatible with the applications.

After the first introductory session was completed, follow-up communications were done on the WhatsApp group (participants are frequent users of WhatsApp) as this was the fastest way to communicate with the participants. Every morning, the researcher had been reminding the participants who did not complete their PRJ or complete the previous task before posting the task for the next session to the Padlet.

[6] *A portable WiFi router that enables user to stay connected to the internet everywhere and anytime. It can be connected to different devices at the same time.*

Table 8.2

Depict how a mobile-mediated learning with Padlet was created

Session One: Timeline	Researcher's and Practitioner's role	Pre-service Teachers' roles
15h00-15h15	Welcoming remarks, connect participants to the WiFi router for internet access and orientation to a mobile mediated learning intervention, allocate participants with participant's code names	Sign attendance register and connect their devices to the WiFi
15h15-15h45	Invited participants to download and install a Padlet App in their mobile devices and join my Padlet, IT Practitioners assisted with the installation of a Padlet App to the mobile devices that were not compatible	Search for the Padlet App from Play store or through Google search engine and install them in their phones
15h45-16h19	Invite participants to listen to the welcoming voice note from the researcher posted on the Padlet wall Invite participants to access a questionnaire, a pre-evaluation and consent form (google form) that the researcher posted on my Padlet wall.	Complete the questionnaire, this was a challenge and the form was not allowing participants to complete it at the same time, the researcher edited the form and emailed it to the participants. This was done after the session
16h19-16h40	Invited participants to introduce themselves on a Padlet wall by stating their pseudonym, school subject specializations and their previous experiences of mobile learning and comment on each other's' posts. Monitor participants posts and observe their participations.	Post their self-introductory on the wall and comment on each other's' posts
16h40-17hoo	Invited participants to complete a PRJ (google doc) posted on the Padlet wall to record their session experiences and daily reflections (this was done immediately and some they preferred to do it after the session) Concluding remarks was done and Session Two for the next day was introduced. Refreshments was served too	Accessed the PRJ form and completed it (some they completed it the next day)

8.3 Data collection and Analysis of mobile-mediated learning Cycle One

The methods of data collection in design-based research can involve the collection of qualitative and/or quantitative data, and it can be collected in cycles of several days, weeks, or even months or years (Herrington et al., 2010). During the implementation of intervention Cycle One, qualitative multiple data (triangulation) was collected from different sources, such as pre-evaluation (*before intervention*) and post-evaluation (*after intervention*) questionnaires, a PRJ (*for every session*) where participants reflect on the process in an electronic journal, activities that were posted on the Padlet wall, participants' works (*artefacts*), peer comments (*dialogue*), as well as observation of participants' engagement. Cycle One data was collected from five different sessions between May 19, 2021 and May 31, 2021, with each activity session posted on the Padlet wall and guided by elements of an authentic learning framework that allows participants to experience real-life mobile-mediated learning tasks.

This also enables each of the selected elements of authentic learning design principles for this study to be tested and refined. Therefore, the hermeneutic cycle-driven analysis (see chapter 2) and evaluation of Cycle One findings was done according to the design principles of authentic learning being enacted. Following the first session of setting up an authentic e-learning context (section 8.2.2), the proceeding session presents the analysis for each session of the authentic M-MLI, Cycle One.

8.3.1 Session One: Provide authentic context *(check understanding)*

Session One was conducted in a face-to-face physically distanced environment (see section 8.2.2 and table 8.2). A Padlet wall was used to create an authentic context and to check understanding of mobile-mediated learning experiences. The first session (19 May 2021) had three main tasks on the Padlet, and participants were given three days to complete the tasks:

Firstly, the researcher posted an ice-breaking task to the Padlet by inviting participants to introduce themselves, share their previous experiences of learning with mobile devices, and comment on each other's posts. Participants had to be engaged in reflection, and this was significant to address their pre-understanding and prior experiences of mobile learning. This was envisaged to enhance participants' awareness of their own historical consciousness about learning (with mobile devices), as Gadamer postulated. *Secondly,* the researcher requested participants to complete a pre-

evaluation questionnaire (google form) (see Appendix D) that was posted on the Padlet wall. Reflection forms part of any action learning session. Providing questions that encourage participants to reflect on their own and others' experiences is crucial to finding actionable solutions that can be applied in the real world (Ferguson et al., 2019). Therefore, a pre-evaluation questionnaire was developed by asking participants questions that stimulate their deep thinking in relation to their daily experiences to be able to link them to new sets of learning. *Thirdly*, the researcher posted a PRJ (see Table 8.3) link on a Padlet wall so that participants could access it to record their reflective forum/learning at the end of each session. In this way, participants reflected on-action and in-action while engaging in the authentic learning context (Herrington et al., 2014).

From the pre-evaluation questionnaire responses, participants said that they use their mobile devices as tools to access/search for educational information or/and online resources rather than using them as an engaging teaching and learning tool during lectures. From the reflection, there are indications that participants recognize the usefulness of mobile phones to their studies. Also, when asked to rate their knowledge of using mobile devices (mobile learning) in their own teaching, two (2) participants rated themselves as poor, while six (6) rated themselves as good or very good. Aside from responses about how useful mobile devices are to their studies and in teaching, most participants (7) were certain that they would integrate mobile devices into their future teaching classroom practices. There was only one participant who was skeptical about the integration of mobile devices in teaching and learning. The participant's argument was linked to the fear of disruption and misuse of mobile phones during the lesson. Subsequently, participants revealed that their knowledge of using mobile devices in teaching and learning is only limited to accessing educational information or/and online resources rather than using them as an engaging teaching and learning tool. These results are akin to those of the fact-finding study (see, Chapter Five).

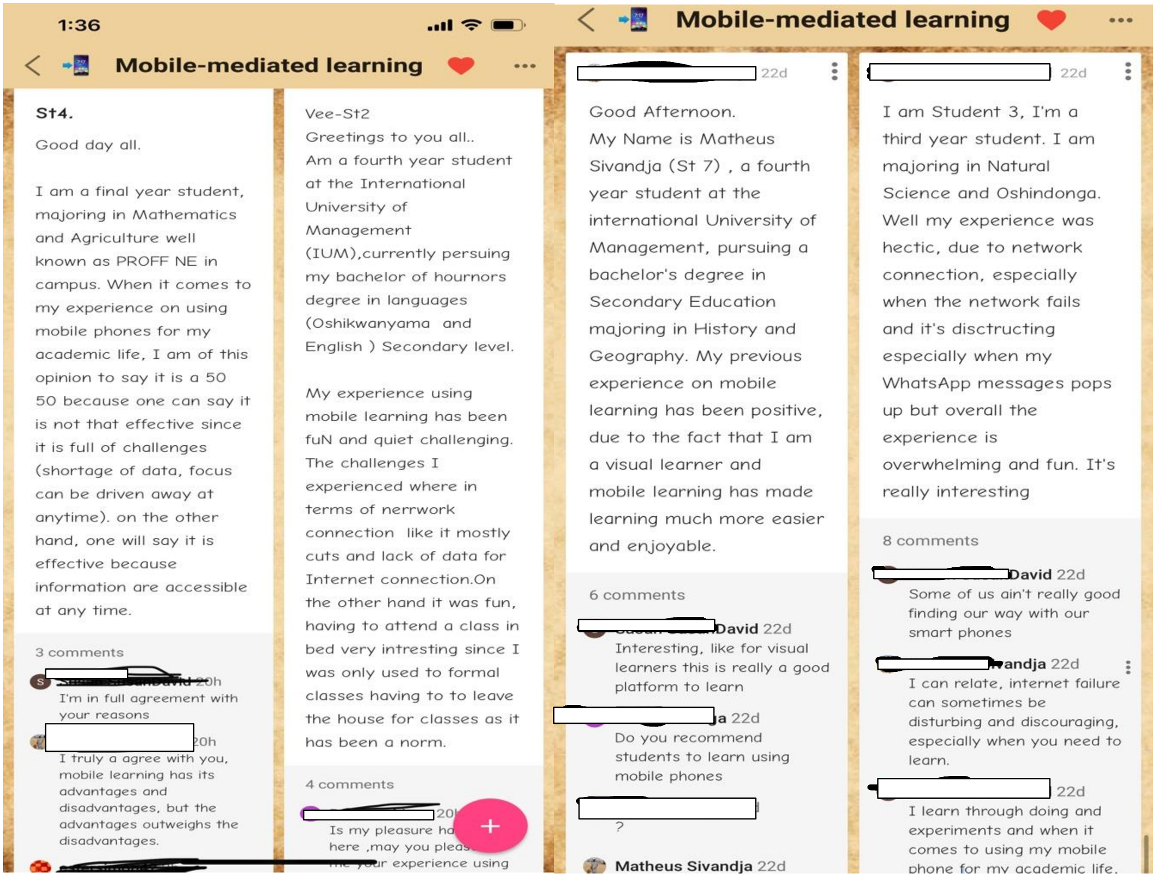
For example, some participants noted:

> ***ST8****: Yes, to search meanings of words when am teaching to broaden their understanding. (Referring to Google Search Engine)*
> ***ST3:*** *Yes, to watch YouTube videos on topics we will cover in the course time.*
> *Another Participant summed up on this notion with reference to learning through fun and likeness of integrating technology in her future classroom teaching:*
> ***ST6****: We are headed to a world where technology plays a role. So, what a better way to use something [referring to Padlet) that will grab the attention of my students and they will learn in a fun less stressful way. I will really love to use mobile phones for my class in the future.*

In relation to the icebreaking tasks (see Figure 8.1) on the Padlet Wall, participants found the Padlet Wall an exciting and useful application for learning through technology-based tools. On the PRJ (see Table 8.3), participants reflected that the Padlet experience was fun, exposed them to new skills and experiences, and they said they enjoyed seeing and commenting on each other's posts.

Figure 8.2

A snapshot from the Padlet for Session One of M-MLI Cycle One



Participants also expressed their challenges that they had experienced at the beginning of the mobile-mediated learning session with Padlet, but later they started to gain interest and enjoy it. showing that the learning context was not simplified (Herrington et al., 2010). For example, one participant wrote:

> ***ST1:*** *To be honest, I was not quite keen on getting to know this whole procedure (Padlet) because it seemed troublesome at the beginning with some few glitches. As we gradually navigated our way through the process, I started enjoying it. I learned more than I thought I would and at the end of the day I did not even want to get off the Padlet wall🤦🏽‍♀️🤷🏽‍♀️🤭😅The session was extremely interesting. [sic]*

One participant encapsulated this idea in the metaphor of saying the Padlet is not user-friendly and how she wishes the tasks were made easier for her:

> ***ST7:*** *The first session was constructive and very productive, as I learned that mobile learning is the future and a good way to include technology in lessons, however navigating Padlet was a bit hard to navigate, as it is not the most user-friendly website that one could find, and other problems such as not installing the application before time and internet problems did make the lesson longer. [sic]*

Participants were asked to download and install the Padlet App on their phones and to post their own introduction without being shown how to do it. This meant that students had to learn how to install and navigate the mobile learning app before they could use it in their future classrooms. In my view, such conceptions illustrate how the knowledge will ultimately be used in real life (Herrington et al., 2014).

At the end of the session, I could argue that the personal learning environment for mobile mediated learning experiences was primed. This enabled participants to reflect, comment on each other's posts, engage in authentic activities that reflect the way the knowledge will be used in real-life situations, and experience learning mediated through mobile devices, which stimulates their learning. Their reflection on the session showed evidence that participants were excited and impressed about the discovery of a new technological educational learning tool (Padlet). The next section summarizes the findings of Session Two.

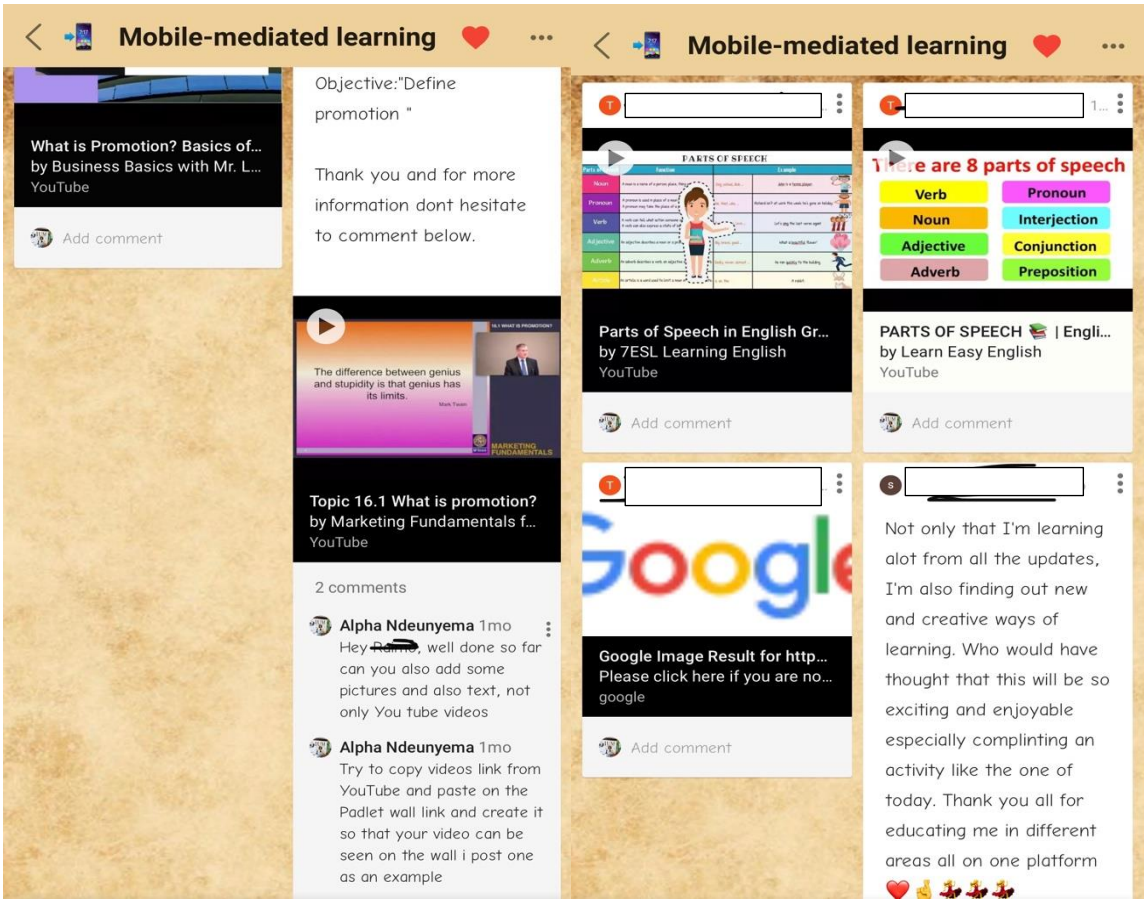
8.3.2 Session Two: Provide Authentic Tasks (engage content learning and support communication skills development)

Session Two was conducted through Padlet Wall and the WhatsApp group (an instant messaging tool). A session task was posted on a Padlet wall that provided an opportunity for participants to complete authentic activities and support communication skills development. Herrington et al., (2010) pointed out that learners can be directed to online resources that can be used to develop their knowledge through specific activities, and different learners can take different paths according to their own needs to complete the task. Participants are then invited to work in pairs (students who are doing the same subject), use one of their specialized school subject's syllabi, choose one topic and one learning objective, and search for related teaching materials for their chosen learning objective using Google search engine, Open Educational Resources (OERs), YouTube videos, Flickr, etc., and post them on the Padlet Wall (see Figure 8.3). Participants' engagement with different online resources encouraged them to capture and share

different forms and types of teaching materials for their chosen learning objectives using their mobile phones or tablets. This form of flexibility greatly enhanced their mobile-mediated learning experiences. Participants were given three days to complete the task (20-22 May 2021).

Figure 8.3

A snapshot from the Padlet for Session Two of M-MLI Cycle One



During this session, the researcher began by inviting participants via WhatsApp group to respond to the task posted on the Padlet wall. Participants were given the whole day to complete this task in their own time, wherever they were. Results showed that participants were posting YouTube videos, websites, PowerPoint slides, images, graphics, etc. on the Padlet wall that were relevant to their chosen topics/learning objectives. The topics that were chosen are: ST1 and ST2: "*parts of speech";* ST3 and ST4: *Management of conservancies in Namibia*; ST5 and ST6: *Population*; ST7: *Earth Structure;* and ST8: *Promotion*.

During the implementation of Session Two, the researcher monitored participants on how they were posting their materials on the Padlet wall and provided guidance where they were struggling. My role was to harness the use of emerging technology in teaching and learning through Padlet. For instance, by pointing participants to useful resources such as creative commons (CC), or open educational resources (OERs) websites, Flickr, and sharing websites, they can find useful materials for their specialized subject and post them to the Padlet wall. Participants were engaged and discussed via WhatsApp and Padlet how to post different teaching materials on the Padlet. From my observation, I initially realized that participants were trying out several encounters and trials of only posting web-links, meaning that materials were not visible or embedded on the wall. I later commented on one of the participant's posts by advising how to post video links so that they can be seen and accessed straight on the Padlet wall. Following my guidance, one of the participants later updated me on the WhatsApp group that he managed to embed the YouTube video on the Padlet as per my instructions. This participant invited others who needed help to contact him, and later he developed a video tutorial on how to embed videos on the Padlet wall. After these interactions, other participants started posting their materials in the same manner.

The authentic tasks enabled a mobile-mediated experiential learning context, which participants appreciated. The results from the PRJ for this session reflected on how participants shared their new instructional learning experiences of using Padlet, and they appreciated independent exploration of acquiring different online teaching and learning materials for their subjects/topics:

> ***ST8:*** *Today's session was so interesting because I learnt a new skill on how to copy and paste videos and Images to the Platform. In 2019 when I was still in my first year I used to think that maybe YouTube was only for Music purposes. In our session yesterday, I came to understand that YouTube hold a lot of information. As long as you have your phone, you are good to learn new things. [sic]*

> ***ST5:*** *The session was very productive and educative, I enjoyed the part of posting the video itself instead of a link, and I understand I will use this in future. This was really great, as to us teachers this session taught us how to give our learners more information on certain topics. I really enjoyed this👍😍.[sic]*

Some they reflected on their journey on how they constructed new knowledge through their personal experiences being engaged with Padlet and collaboration with peers:

> ***ST1****: Okay!! So today was a bit tricky when it came to copying and pasting the links regarding our chosen topics from the syllabus. One of our colleagues said he can help us if we struggle with that part but being me, I decided to struggle and figure it out on my own until I finally got it right! This Padlet experience is*

surely teaching me new tricks I tell you, to the point where I wanted to keep on uploading images and videos but I had to stop😅 the task becomes enjoyable once you start learning how to do it correctly.[sic]

ST6: *Today's session was really awesome. I had my struggle especially with posting the link that will show correctly on the padlet. Thankful to my partner who came through. I'm gaining new skills and learning new experiences. I'm grateful for this opportunity. [sic]*

ST2*: Honestly my experience for today was amazing, I am getting to love this application more than I was expecting. ..am asking myself why I did get to know about it earlier than this but well am still grateful that Ms Alpha introduced me to this amazing and user friendly app👏👏👏it's never late and I trust I chose a path filled with more exciting new experiences and I just can't wait to see what is in store for us 🤣🤣🤣🤣👏'waaw'😱Padlet is the plug. 👇👇. [sic]*

Authentic tasks in mobile-mediated learning experiences appeared to help participants reflect on previous knowledge (past) and connect it to new knowledge (present). Participants with prior experience get on with the authentic tasks without having to spend unnecessary time covering content that they are already accustomed to (Herrington et al., 2010). For example, searching for information/teaching materials through Google's search engine and YouTube. Participants' past (part) meets the present (whole), which is the use of Padlet as a technological tool that mediates teaching and learning. This could be why they appreciated the mobile-mediated learning experiences, which influenced a shift in disposition towards mobile learning.

At the time of the study, most schools and universities in Namibia were using a blended learning approach due to the COVID-19 pandemic that brought uncertainty in terms of teaching and learning mode. This was adopted for fear of the universities/schools being put on lockdown again. One participant (student 7) embraced her prior knowledge and how new learning makes sense in the context of her studies, rethinking of pedagogy during the COVID-19 saga. Her comment exemplified this.

> ***ST7:*** *Today's session was very interesting and easy, because due to the Novel [coronavirus] Covid-19, we were kind of forced to learn how to upload assignments in pdf and word formats with different links on the University's online platform [IUM-LMS] and because of that, it made today's activity much easier.*

While taking cognizance of the tragedy that the COVID-19 outbreak impacted on the well-being of society globally, the above statement focuses on the positive approach of transforming teaching and learning with technology, which meets the pedagogical demands and the challenges that universities encountered during the pandemic. Such

learning towards real-life relevance is fundamental to authentic learning (Herrington et al., 2015), allowing participants to create meaningful and relevant artefacts for their subjects. What was interesting in this session was that participants reflected not only on the authenticity of the task that was given to them but also on how the task was relevant in their personal learning environment (opportunity for the detection of relevant versus irrelevant information), how the acquired knowledge could be enacted in their future classroom teaching (involvement of the student's beliefs and values), and how they were learning from each other (collaboration) (see, Miller, 2012). It is evident that mobile-mediated learning experiences generally create a transformative, harmonious environment of teaching and learning with technology. The next session summarizes the findings of Session Three.

8.3.3 Session Three: Multiple roles and perspectives *(engage and check understanding)*

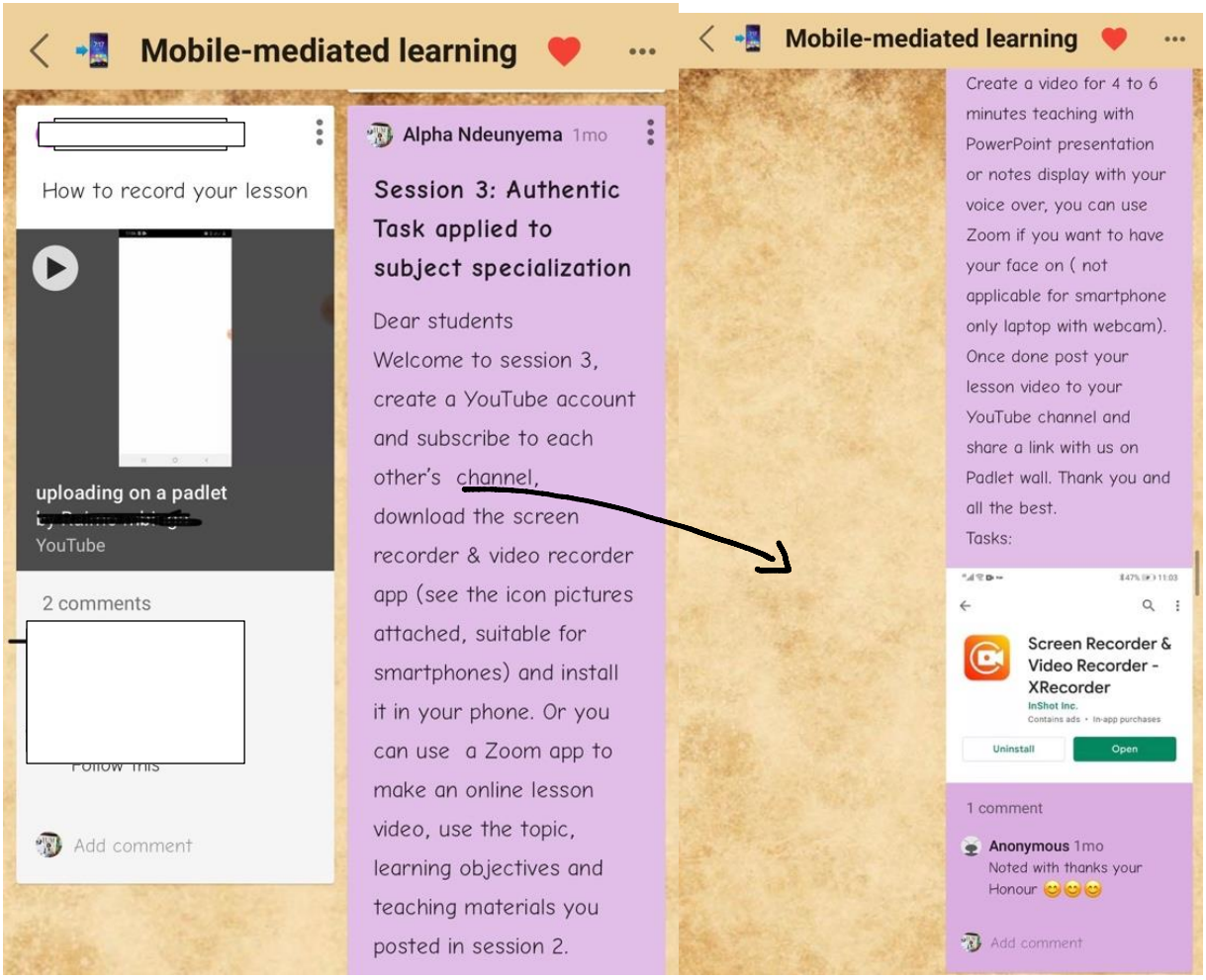
In any complex learning design, a single perspective, such as that of participants searching and posting teaching material for their subject content objectives on the Padlet, is insufficient to reflect the authentic nature of the task (Herrington et al., 2010). Participants were engaged by inviting them to participate in multiple authentic activities with peers, educator (researcher), access to other peers, different web-searches, online readings, use of other supportive web-based apps or mobile apps such as WhatsApp, Screen Recorder and Video Recorder-XRecorder App, creating teaching content for mobile devices, developing and constructing a videocast, creating a YouTube channel account and posting their videocast, subscribing to each other's channel, and sharing their YouTube video links with others via a Padlet wall using their mobile phones. (See Figure 8.4, Session Three task) to complete the task. These enabled participants to examine the task from different practical and theoretical perspectives, using a variety of resources through a mobile-mediated learning context in their subject specializations.

Step 1: As shown in figure 8.4, participants were asked to create a YouTube channel and post the link to the Padlet wall so that others could follow and subscribe. *Step 2:* Participants were requested to download and install a mobile application called Screen Recorder and Video Recorder-XRecorder, which is compatible with all types of mobile phone operating systems. *Step 3:* Participants were asked to use the recorder app to create a 4 to 6-minute video lesson using the topic, objective/s and materials collected from Session Two with their voice over. *Step 4:* Participants were asked to upload their

lesson videos to their YouTube channel and post links to the Padlet wall so that others could listen and comment on them. Participants were given three days to complete this task (23-25 May 2021).

Figure 8.4

A snapshot from the Padlet for Session Three of M-MLI Cycle One



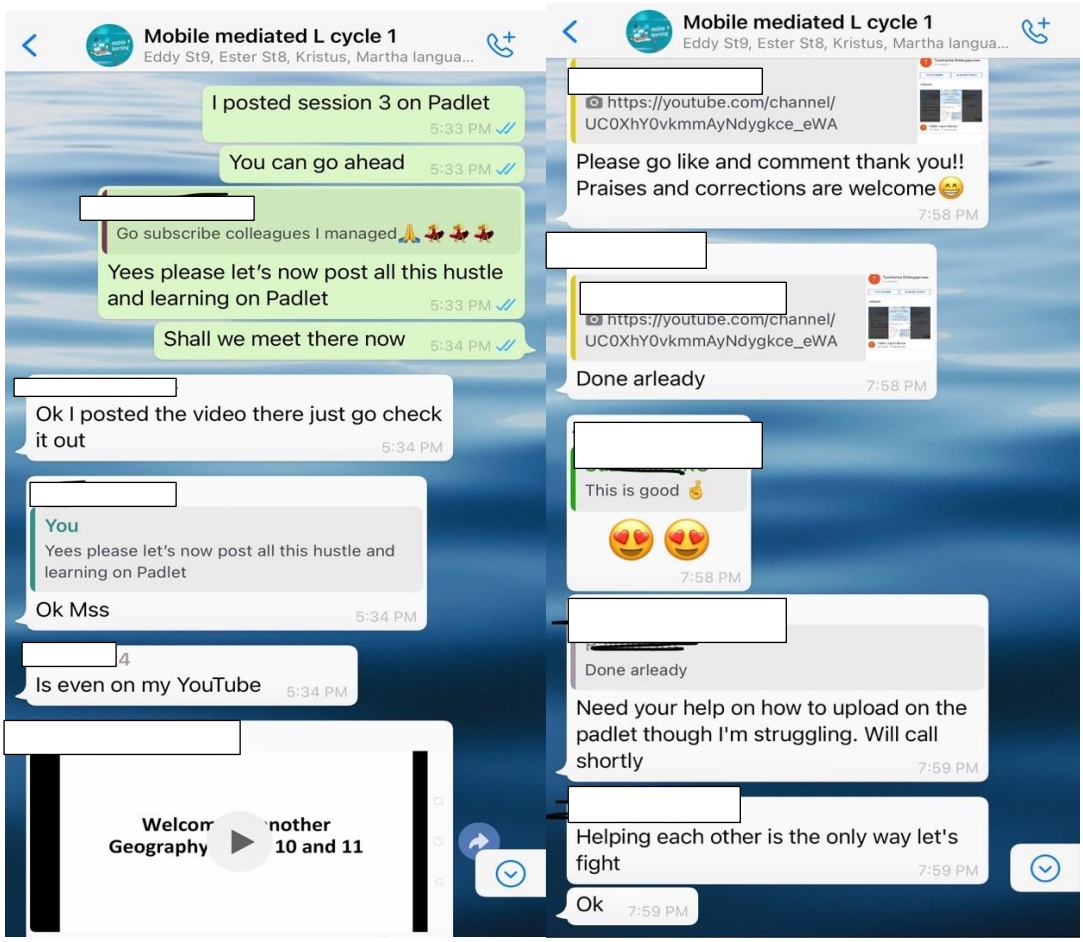
The authentic task for Session Three highlighted that participants were given the opportunity to examine the tasks from different perspectives, using a variety of resources and technological tools. Participants interacted more on a WhatsApp group than on a Padlet wall during the session. For example, when they were posting their YouTube channel links for others to subscribe to, asking others how to create screen casting lesson videos with voice over, etc., they were posting their queries or discussion on the WhatsApp group instead of the Padlet wall.

This is evidence that participants were regular users of WhatsApp. The researcher's role was therefore to scaffold and monitor participants' posts on a WhatsApp group and

redirects them to post their discussion, comments, or tasks on the Padlet wall, which was the selected mobile learning tool. Contrary, the researcher advised participants to prefer posting notification of their collective activities on the Padlet wall through WhatsApp (see Figure 8.5) to inform each other. As a result, WhatsApp was used to mediate notification/announcement among participants and the researcher of what was happening on the Padlet wall (mobile learning platform). This implies that WhatsApp complemented Padlet by supporting participants' task engagement, thus affordance of participants' orientation towards mobile-mediated learning.

Figure 8.5

A snapshot from WhatsApp group posts during Session Three



Furthermore, participants were also provided with directions when confronted with complex challenges by the researcher. For instance, by pointing them to useful resources such as materials from creative commons (CC) or open educational resource (OER) websites, sharing website names or applications where they can find useful guidance to complete the task. In addition, the researcher was initiating conversations

and posting reminders both on WhatsApp and Padlet on the timeline so that they could complete the task within the allocated time frame without frustration but through their own efforts.

From my own observation, I could conclude that Session Three was, to a large extent, successfully completed. At the beginning of the session, I observed how participants were struggling to create videos with voice over and the way they were interacting and engaging with one another, sharing ideas on how to develop a pre-recorded video lesson etc. on the WhatsApp group. I have also observed that some participants were struggling to align their voices with the slide shows, while others were only showing one fixed slide or web-page to explain the topic. However, after my interactions and guidance with the participants without simply showing them how to develop a video lesson with voice over, I was finally impressed by this video https://youtu.be/jF68mY1hE6c developed by ST2, in which I advised other participants to follow a similar technique and the participants to further assist each other on how to create a good online lesson video. Consequently, participants were not simply just participants; they were also inhabiting the role of a teacher and learning how to develop online lessons for their learners with the support of mobile technological tools. This enabled participants to 'criss cross' the learning environment or resources according to authentic learning principles (Miller, 2012) and deal with complex issues to enhance understanding of their subject pedagogical practices from multiple perspectives.

Findings from the PRJ for Session Three revealed the success of authentic mobile-mediated learning. It was evident from participants' reflections that they were successfully and actively engaged in different activities of the mobile-mediated learning environment, which enabled a fusion of horizons. Most participants appreciated their experience and, at the same time, reflected on the challenges that they encountered during the enactment of the task:

> ***ST4****: This session was a bit challenging on my side since I have been trying to upload the video and it took a lot of time for it to go through. I can't finish thanking my friends who helped me out. I like the experience I am getting.*
>
> ***ST5:*** *Today's session was challenging, I was finding it so hard to create a YouTube video and paste it, however I managed to do it. It was a very good experience and I feel like I am the one now when it comes to the use of technology in class. Today's session also taught me how to follow instructions and listen very well as one of my colleagues was instructing us on how to come*

up with our video. Wooooow, what an enjoyable session. Dankie [Thanks] Ms Alpha👏👏👏.

ST6: *Today was quite challenging. As much as I enjoy the new knowledge and skills gained, I'm [was] also struggling. I had difficulties with creating a YouTube account and handed it to my colleague who came through. I remember when I first used a XRecorder, I pressed recording but I didn't realize that everything I'm doing on the screen is being recorded 😂😂, I only came to realize it later. Overall I'm loving this and I'm getting ideas on how I will be using the Padlet for my career.*

ST8: *It was not easy, but wow I managed to prepare my lesson using my phone which makes it easier to learn using my mobile*.

Some participants wrote comments that reflect on the relevance of peer discussion and collaboration, which created an opportunity to partake in a dialogue with others during the process:

ST1: *First and foremost, big ups to my colleague Raimo. I was becoming a bit frustrated until I decided to seek help from him. At the end I managed to record and upload my video. I almost surpassed the minutes because I enjoyed it so much and I almost forgot to come fill in my PRJ😂 but here I am anyway! [sic]*

ST2: *Am enjoying how we are learning from each other you guys. That's why the word" Teamwork came into existence moshili [is true] neeh✍. Am enjoying this too ,you guys this is just too nice than I was expecting it to be 🤣👏 see what I thought about this👇👇👇……. but eish am enjoying this now, [I] am singing Padlet in my house everytime, my housemates are wondering what is this Padlet thing this creature keeps talking about😂.*

Some participants allude briefly to the bigger picture of remote learning during the COVID-19 pandemic and the transformation of teaching in the fourth industrial revolution through technology:

ST5: *…. but overall, it was a good experience and as a student teacher I really learned a lot who knows I might use the skills and knowledge that I picked up in my lessons [mobile mediated learning sessions], I mean we [are] still with Covid-19 so what could be better way of learning than learning online🤦🤦🤞*

ST8: …. *As we are in the 4th [industrial] revolution it's good to encourage our children [learners] to use technology because it makes things easier and I am so happy to be part of this fascinating group, learning new things from my peers.*

Following the presentation of participants' reflection and artefact findings for Session Three, it is my view that participants were actively engaged and participated in the collaborative learning process by applying past knowledge and constructing new

meanings mediated through technology-based (present) such as the Padlet tool. This provides insight and understanding of how pre-service teachers can participate in an authentic mobile-mediated learning experience. To this end, participants were able to construct knowledge through their personal experiences by being engaged in emerging mobile-mediated technologies, personal interaction with others, and sharing their own experiences, thoughts, and challenges. Given that participants used a variety of resources to examine the task from various theoretical and practical perspectives that required them to complete the task, the design principle of providing opportunity for multiple roles and perspectives that are available in real-life challenges was successful to a large extent. The next session summarises the findings from Session Four.

8.3.4 Session Four: Support collaborative construction of knowledge (*strengthen understanding)*

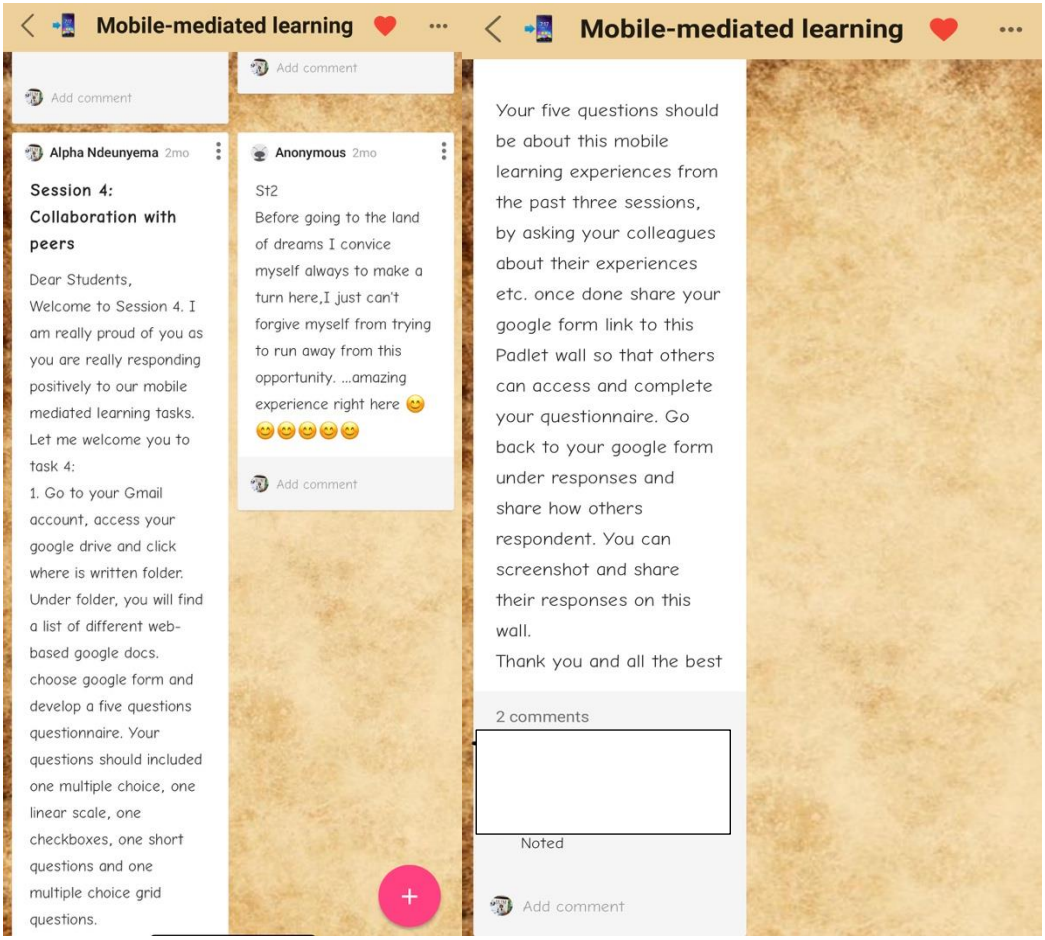
Following the implementation of sessions one, two, and three, Session Four was developed to strengthen the understanding of mobile-mediated learning through collaboration and teamwork. Authentic activities require collaboration, which is essential to the task. So success is dependent on it (Rowe et al., 2013), for whole group achievement. Besides, Gadamer postulated that a genuine understanding is imagination, that is, "the capacity to see what is questionable in the subject matter and to formulate questions that question the subject matter further" (Clark, 2008, p. 59). For this reason, participants were invited to develop their own Padlet experience evaluation questionnaires using Google Form (see Figure 8.6), share their questionnaire with peers via Padlet, comment on each other's questions, complete each other's questionnaires, and then report on their findings using the mobile phones. This task allows for the collaborative construction of knowledge (Van der Merwe, 2015) through the creation of a fictitious intervention evaluation questionnaire using Google Forms and posting on Padlet. Moreover, collaborative construction of knowledge was also achieved through the sharing of tutorial videos that some participants created and shared with each other on how to develop an online questionnaire using Google Form.

On the other hand, participants were not given research questions or told what to ask in their questionnaires. Rather, the process for Session Four required participants (pre-service teachers) to reflect on their own experiences, guide each other on how to develop evaluation questionnaires based on their own needs and reflections, and engage in dialogue, thereby empowering them to take control and ownership of their

learning. This attests to the strategies that help to transform pedagogical delivery from an authoritative, instructivist mode to a collaborative, connectivist approach (Rambe & Bere, 2013). While participants were given control and ownership of their learning, the researcher provided participants with clear guidance and directions on what should be done to complete a task. Therefore, participants were invited to only develop five research questions (see, Chapter Seven, Table 7.1), consisting of *one multiple-choice question, one linear scale question, one checkbox, one short question, and one multiple-choice grid question.*

Figure 8.6

A snapshot from the Padlet for Session Four of M-MLI Cycle One

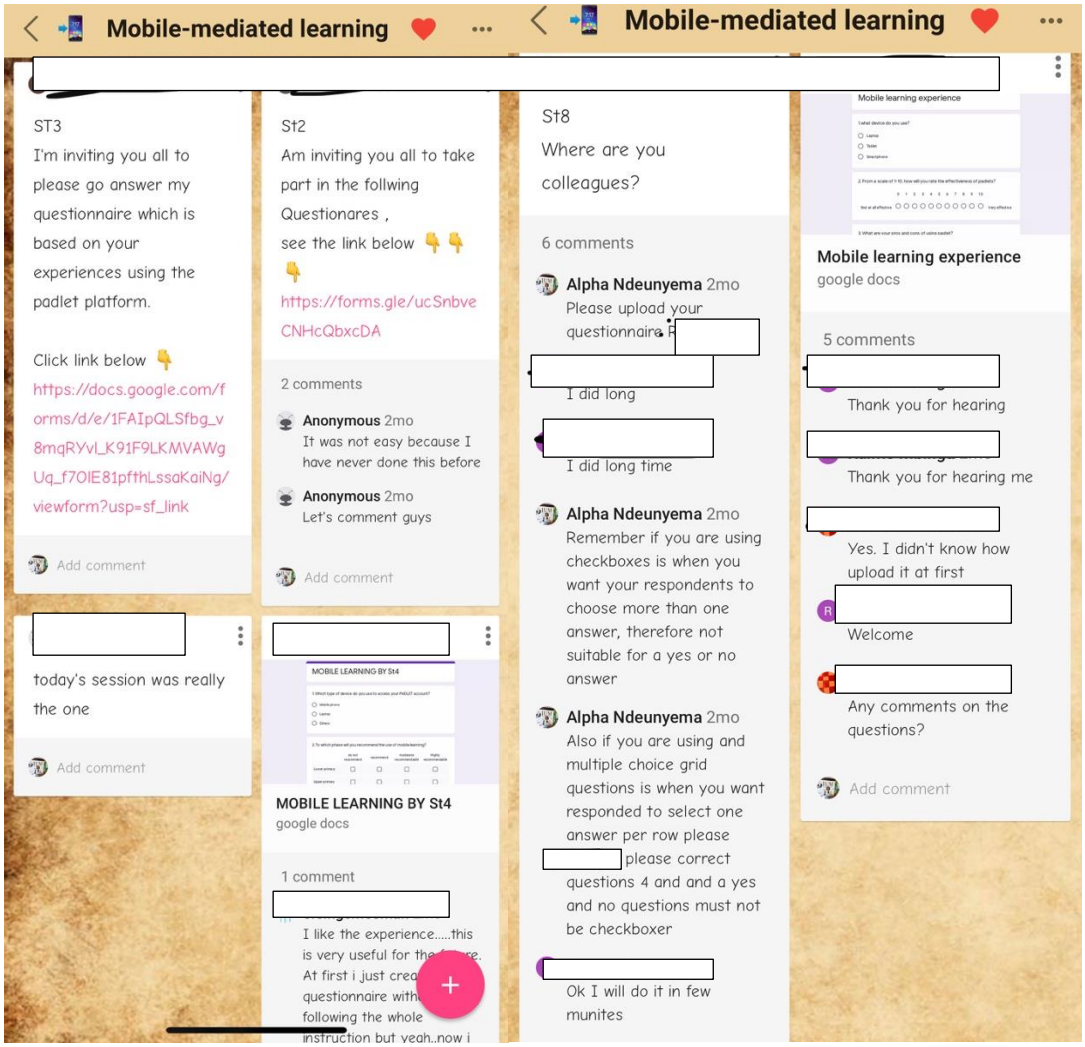


As mentioned earlier, WhatsApp features an instant messenger. It allowed participants and researchers to notify each other when changes or comments were made on Padlet during the process of developing their evaluation questionnaire using Google Form. It is worth noting that this task was not fully completed as participants did not share their findings from the questionnaires, perhaps due to time constraint as participants were

about to start with their semester 1 examination. However, I can attest that this session was 90% complete, as a full implementation was flagged for revision during the second iterative cycle's implementation. Participants were given three days to complete this task (May 26-28, 2021).

Figure 8.7

Shows an excerpt of participants' responses to Session Four task on a Padlet wall

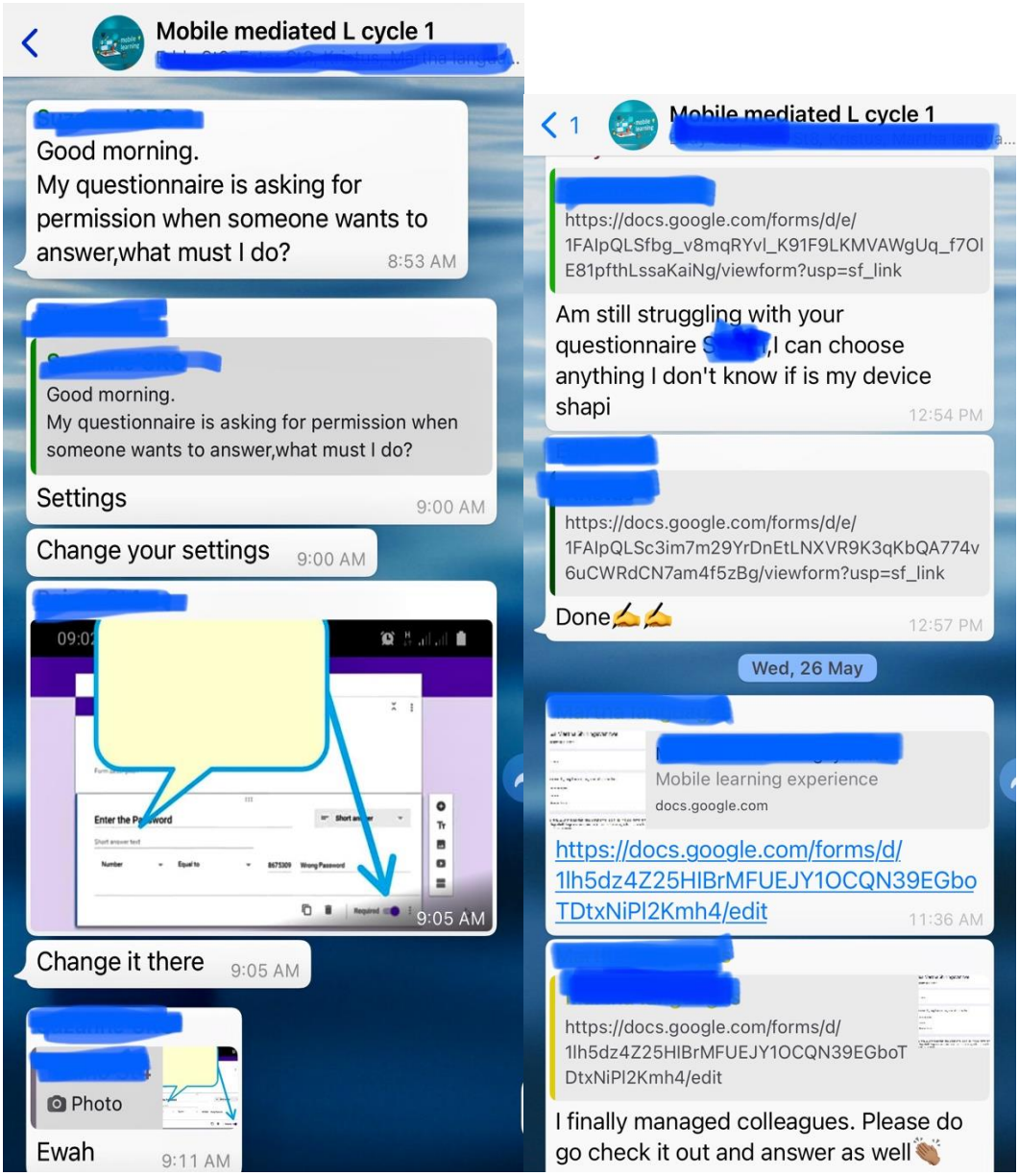


Following my observation findings from the Padlet (see Figure 8.7), participants were engaged in a dialogical conversation between each other's and the educator, which would yield the collaborative mobile-mediated learning experiences. Having made a case for ontological account of dialogue, Gadamer's philosophy advocates that understanding can be seen through the metaphor of a conversation (Shapcott, 2011). During the session, participants were engaged in a process of question and answer between conversational peers and educator through artefacts. In this context, the Q and A are accommodated towards achieving a fusion of horizons for mobile-mediated

learning. I argue that the collaborative critical reflection among the participants should be promoted using it to guide the design of further mobile-mediated learning experiences. None of the participants designed an online research questionnaire before. Results from Session Four shows that participants enjoyed sharing their experiences, questioning others about their Padlet experiences, learning new skills of developing an evaluation questionnaire with google forms and learning new thing from each other's.

Figure 8.8

Snapshot from WhatsApp group notifications during Session Four



Participants engaged with each other in dialogue on the WhatsApp group (see Figure 8.8), for instance on how to improve their developed questionnaires:

> ***ST3****: Guys, I am busy answering all your questionaries dropped on Padlet and it is soo much fun please do go and answer mine or comment.*
> ***ST3****: My questionnaire is asking for permission when someone wants to answer, what must I do?*
> ***ST8:*** *response to ST3 question: change your setting [referring to the picture attached with an arrow depicting how to do it]*

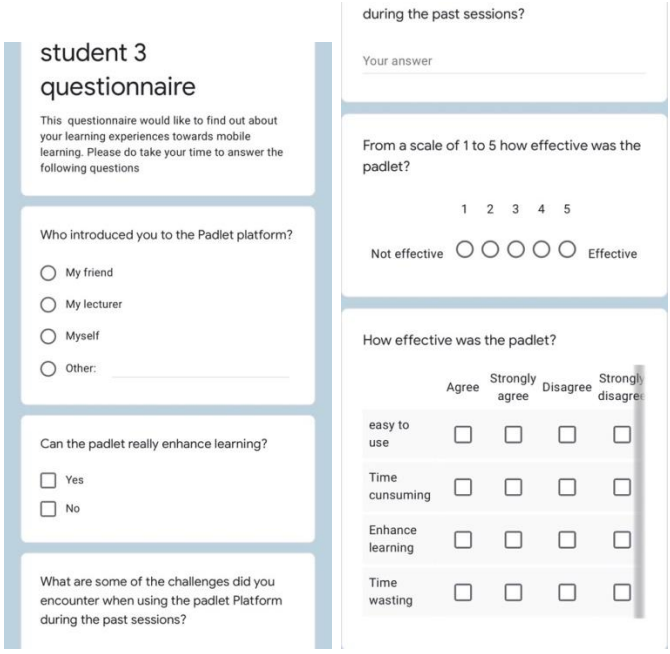
While on the other hand, participants were also commenting on each other's questionnaires and pointing to the challenges they were encountering during trial and error:

> ***ST2****: I am still struggling with [to complete] your questionnaire*
> ***ST4****, I cannot choose [select] anything I do not know if it [is] my device or what?*
> ***ST8*** *was seen as a peer support/coach, someone who could be approached for assistance:*
> ***ST7****: Bro [Brother referring to* ***ST8****] please create a screen recording [****referring to the Session Three task videocast pedagogical approach****] quickly of how you did yours, I want to see something quickly.*
> ***ST6:*** *I am struggling @****ST8*** *please help*
> ***ST2****: I am having trouble @****ST8*** *where do I go first?*

Session Four task provided participants with space for reassurance, collaborative approach and help each other to improve and complete their work (see Figure 8.9 sample).

Figure 8.9

Sample Participants' fictious research questionnaire artefact produced during Session Four



This demonstrate the potential ways in which dialogue and collaboration are important for both shared problem solving and shared knowledge production (Herrington et al., 2015). Overall results from my observation shows evidence that participants had shown that they were empowered through their learning, and they believed in each other's by sharing knowledge and elicit their opinion of the Padlet.

To this end, the artefacts emerged from Session Four produced by participants, also serve to help authenticate the evaluation of a mobile-mediated learning experience. Evaluation is considered as a crucial and powerful tool within the overall initiative to develop and implement authentic e-learning (Miller, 2012). It is within this context that participants were given opportunity to also learn evaluation skills and strategies of a mobile-mediated action learning experiences.

Subsequently, PRJ for Session Four reflection indicated that participants appreciated the authentic collaborative activities, and they acquired skills on how to develop a mobile-mediated learning evaluation questionnaire. These insights are reflected in the following representative comments from the PRJ:

> ***ST3:*** *Today's session was very successful and exciting 🤩🤩🤩🤩. I finally created my first questionnaire and it was so much fun but as always, I couldn't have done it without a teamwork and corrections from here and there. I really enjoyed the session. I acquired new skills that I never knew I possessed. I keep learning something new each and every time and today I can proudly say that network was not a challenge to me [sic].*
>
> ***ST7****: found today's task a little bit challenging, because I'm used to creating questionnaire manually and not digitally, so with the help of my friends, it all worked out.*
>
> ***ST8****: Today's session was something else, because I could not believe it on how I completed setting up my online questionnaires. Furthermore, I came to understand that teamwork is the key to success and I learnt how to be a critical thinker. It's becoming tough but together with my colleagues we can make it possible [sic].*

Participants were also motivated and excited because of their personal involvement, especially when they had to develop a digital questionnaire that they have never done before, their contribution to mobile-mediated learning and contribution to their future studies/teaching:

***ST6**: This was my first time setting up a digital questionnaire and I had some challenges with the checkboxes question, first, I didn't set it properly as I didn't know what it should look like. But now I can proudly say that I set up a good questionnaires using different questioning techniques*

***St4**: Everyday is a chance to gain some new experience. Today's session was a bit challenging since it was the first time for me to create a questionnaire. I have learned so much during the first four sessions and I believe that I won't find it hard during my research project because I was exposed to so many things that will help me during the time of developing my research project instruments [sic].*

***St2**: Wow, task 4 was just amazing and very much educational. Learning to develop questionnaires was really worth learning and I believe this will be useful to me in the future as a teacher .like now we are living in the era where technology is stressed in schools due to circumstances for instance COVID-19,so learning how to develop questions using Google form was just amazing [si]*

8.3.5 Session Five: Promote reflection to enable abstraction to be formed (*Reflect on learning + planning for future connections)*

Following the implementation of Session one, two, three and four, Session Five, was developed to reflect on the mobile mediated learning experiences and enable abstraction to be formed for future teaching and learning with mobile devices. Authentic activities provide participants with the opportunity to reflect on learning, both individually and with peers (Rowe et al., 2013). Session Five provided participants with opportunity to reflect on their mobile mediated learning experiences in the form of questions and reflection on their own work. An online post-evaluation (reflect on-action) questionnaire (see Appendix E) was developed via google form and shared the link on the Padlet wall to re-evaluate participants' experiences and stimulate further thinking after intervention.

The post- evaluation questionnaire included a mix of Likert-scale (five-point scale ranging from 1 strongly disagree to 5 strongly agree, 1 not at all confident to 5 extremely confident as well as 1 not at all committed to 5 extremely committed) and open-ended questions. Participants were also encouraged to articulate their understanding, views, and new ideas they gained during mobile mediated learning intervention on the PRJ (reflect in-action) after each session.

The post-evaluation questionnaire consisted of seven main questions (five close-ended and two open-ended) aimed at finding out:

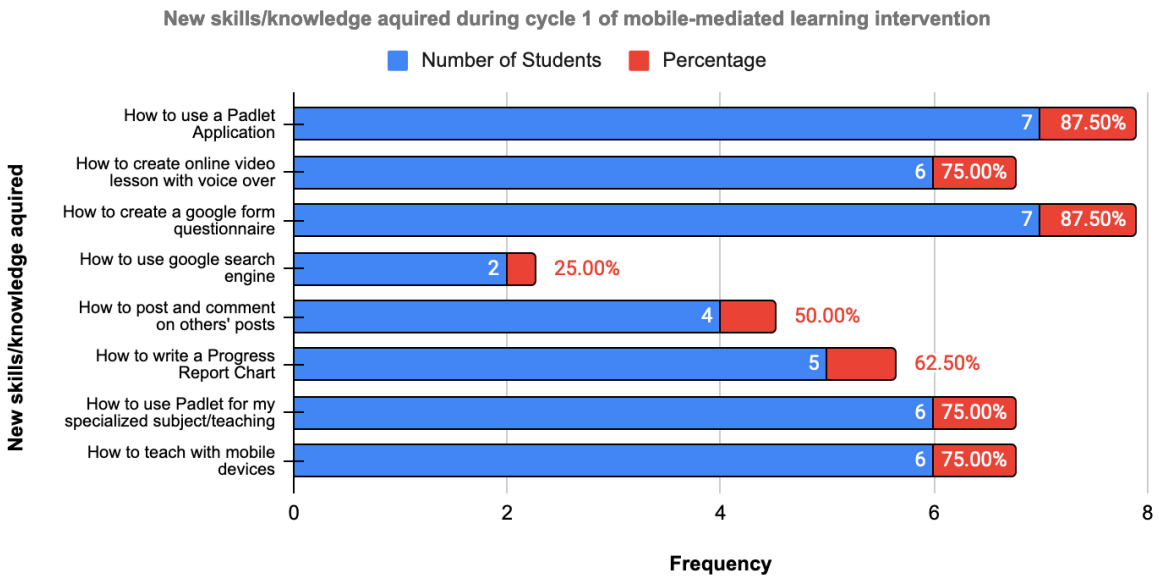
- How participants (pre-service teachers) reflect on the mobile-mediated learning experiences and to determine whether there is a shift in disposition and their views of integrating mobile devices in teaching and learning [see Research Question 2 (RQ2), Chapter One].
- To determine whether the authenticity construction of knowledge was achieved (from not at all confident to extremely confident) and whether participants are willing to apply what they learned to their future teaching classroom (from not at all committed to extremely committed).
- To identify new skills/knowledge that participants acquire during M-MLI Cycle One.
- To uncover the elements (from strongly agree to strongly disagree) that contributed to the construction of knowledge through mobile-mediated action learning and completion of authentic activities among the participants.
- To ascertain what constrain or enabled the mobile-mediated learning among the participants (see RQ4, Chapter One) that would make them better able to apply what they learned in their future teaching.
- To identify how transformation in disposition was achieved to adopt mobile devices in future classroom teaching (see RQ1, Chapter One).

All eight participants participated in the online post-evaluation survey. Participants (87.5%, n=7strongly agreed; 12.5%, n=1 agreed) reported that Padlet helped them to learn, they also indicated that they were fully engaged during the intervention and they will recommend other participants to integrate the same experience in their future teaching, although one participant indicated that she is neutral to that notion. Furthermore, most participants (50%, n=4; are extremely confident; 37.5%, n=3 are confident; and 12.5%, n=1 moderately confident) reported that they will apply what they learnt during intervention into their future teaching. On the other note, participants (50%, n=4 are committed; 37.5%, n=3 extremely committed; 12.5%, n=1 moderately committed) indicated that they will apply skill/knowledge acquired during intervention to their future teaching. Findings indicate that the experience of mobile-mediated learning was a positive enhancement across the range of authentic activities for participants, with no direct negative aspects identified. The most valued experiences were the use of Padlet Application and the new experiences gained.

Figure 8.10 below indicates that participants acquired new skill and knowledge from Cycle One of mobile-mediated learning experiences such as how to usus a Padlet application, and how to create a questionnaire using google form (87.50%). Participants also indicated that they learned new skill such as how to create online videocast lesson with voice over, how to use Padlet in their specialized subjects/teaching and how to teach with mobile devices (75%). On average, some participants (62.5%) indicated that they acquired new knowledge on how to write a PRJ and how to post and comment on each other's posts. However, only 2 (25%) participants indicated that the new skills/knowledge they learned is how to use google search engine, this inferred to the notion that most of the participants are regular user of google search engine (past experience) (see Table 8.1).

Figure 8.10

New skill/knowledge acquired during M-MLI Cycle One



Thus, the hermeneutic notion of learning experience alluded that the past (part) experiences is used to bring new meanings to the present (whole). In this case, the fusion of horizon was enforced among the pre-service teachers (participants) through reflection and revisit their past experiences or understanding and align it with the present experience to create new understanding of mobile mediated action learning experiences.

Following the factors that aided participants to complete the authentic mobile-mediated learning activities (Question 5), most participants (75%, n=6 strongly agreed; 12.5%, n=1 agreed; and 12.5%, n=1 neutral) appreciated the extra guidance and instructions that they got from the instructor (researcher). Furthermore, benefits of the posts on the Padlet wall such as chats and comments (87.5%, n=7 strongly agreed; 25%, n=2 neutral) were also authenticated by the participants. On the other hand, all participants (62.5%, n=5; strongly agreed; and 37.5%, n=3 agreed) appreciated the assistance from peers (collaboration), chats on the WhatsApp group as well as their own efforts and discipline in shared construction of knowledge. There was also a sense of participants (37.5%, n=3 strongly agreed, 25%, n=2 agreed; 25%, n=2 neutral; and 12.5%, n=1 strongly disagreed) connecting their past experiences of using their mobile phones (such as access learning resources, WhatsApp instant messaging, google search etc. see Table 8.1 and Chapter Five) to draw upon and complete the authentic activities experiences which transform learning. In contrast, participants (37.5%, n=3 strongly agreed; 37.5%, n=3 agreed; and 12.5%, n=1 neutral) confirmed that the YouTube video tutorials that were shared by the instructor allowed them to understand and complete the authentic activities for mobile mediated learning approach. However, one participant (12.5%, n=1 strongly disagreed) perceived the videos tutorial not helpful.

Table 8.3

What suggestions do you have that would make you better able to apply what you learned in your future teaching? (Question 6)

Researcher's Intention	Participants' (pre-service teachers') responses, experiences and reflections	Researcher's (Educator's) Comments
To ascertain what constrain or enabled the mobile-mediated learning among the students (see RQ4, Chapter One) that would make them better able to apply what they learned in their future teaching.	**ST5:** When it comes to mobile learning, it is of utmost importance to give your full and undivided attention because you can easily make small errors	This suggest that mobile learning requires efforts and commitment to be able to develop quality work/teaching
	ST7: My suggestion is for all students that are pursuing their studies on Education to be trained on how to integrate ICT in all their lessons. **ST1**: I suggest that all the students' teachers should be introduced and trained on how to use this platform because it will make our teaching easier. Learners will enjoy learning since they will be using their phones.	These support the motivating factors of integrating mobile learning into pre-service teachers education setting such as modelling teaching and learning through mobile devices (see, Baran, 2014)

	ST6: Schools and institutions must allow the use of device by learners to learn so I can be able to apply what I have learned here to teach them. **ST2:** Before tasks are posted, there should a manual or training that one needs to undergo on how to use the Padlet, to make it easier when completing a task	This suggests that enhancing opportunities for learning practices and provide orientation for a selected mobile tool/s will make it easier for students to complete the authentic activities.
	ST8: Practice and starting using Padlet with my colleagues **ST3:** …I should start exposing myself more to different kinds of teaching applications that the internet offers and try to move away from the traditional type of teaching and move to the more modernized and technological way of teaching.	These students advocate the necessity of exploring the pedagogical practices and engaging students in multiple mobile-mediated learning tasks to be able to apply and adopt what they learned in their future teaching. Collaboration is also appreciated here.

Table 8.4

After your mobile learning experiences, will you use mobile devices in your future classroom teaching? if yes explain how, if no explain why not (Question **7)**

Researcher's Intention	Participants' (pre-service teachers') responses, experiences and reflections	Researcher's (Educator's) Comments
To identify how transformation in disposition was achieved to adopt mobile devices in future classroom teaching (see RQ1, Chapter One)	**ST5:** *It depends* whether most or majority of my students will have access to mobile devices which are able to download all necessary apps that are needed when it comes to mobile learning… **ST7:** *Yes*, Because the perception that I had in the past that goes like; "learners will not use the mobile phone for what they are intended for " is gone after being introduced to it and after seeing how enjoyable it is.	The perception of this student suggest that accessibility and connectivity of mobile technologies is very crucial for the adoption of mobile learning in future classroom teaching
	ST1: *Yes,* I will use my phone to set up my tests, assignments and projects to mention but a few. **ST2:** *Yes,*my learners will engage online and I will be monitoring their work in the comfort of their houses not only will this enhance their learning experiences it is also fun, it's like a class at home.	This suggest that transformation in disposition was achieved and this student's pre-conceived judgment of using mobile phone as a teaching and learning tool is now addressed and new knowledge is constructed (*hence: the past views was transformed through M-MLI= present*)
	ST8: *Yes*, …I will record audios lessons and if any learner missed the lesson, they can always access it and listen to the recording **ST4:** *Yes,* I will use it in a way of presenting my lessons when am absent and sent to my learners for them not to be left behind.	These students speak to the notion of mobile devices that it allows access to information and learning resources "anytime and anywhere". They also commented that mobile learning makes learning more fun and allows them to create multiple teaching and learning activities
	ST3: *Yes,* … it enhances learning and it is also another way of integrating technology in the classroom **ST6:** *Yes*, because it enhances learning. learners will enjoy using it	This suggests that students saw the potential of mobile devices as a teaching tool that it can enhance learning.

It can be inferred from (see Tables 8.3 and 8.4) the above qualitative comments to the open-ended questions which shows positive experiences of mobile-mediated learning among the participants (pre-service teachers). Participants exhibited capacity to align their past views and construct new knowledge during mobile-mediated learning process which in this case involved making decision to change how they will teach in their future classroom. As the reflections by participants suggest, the authentic mobile mediated learning activities were to some extend effective in challenging their pre-conceived views about mobile learning. Participation in the authentic learning context that reflect the way knowledge will be useful in real life (Van der Merwe, 2015) was also evident in the first iterative cycle of this study. Subsequently, mobile mediated learning artefacts provide insight on how participants (pre-service teachers) can actively participate in a shared constructing of knowledge given multiple roles and perspectives which can be facilitated by experiential learning. Hence, the intervention for the first iterative cycle of mobile mediated learning experiences was effective.

8.4 Iterative Cycle One of mediated-mobile learning intervention discussion of findings

Design guideline1: Provide authentic contexts that reflect the way the knowledge will be used in real life

In Cycle One of intervention, participants were provided with the real-world relevance of mobile-mediated learning experiences as presented in Session One which to some extend was successful. However, this design principle is indicative of the need to choose appropriate technological tool/software that is compatible to any mobile phone system and internet connectivity to enable educator to design real life context and personal learning environment for mobile-mediated learning. Meaning, availability of internet connection and mobile devices to enable pre-service teachers to access the learning authentic context that reflect the way mobile learning can be used in real world practices is very relevant for the adoption of mobile learning. For example, some participants commented that: “It depends [*referring to the perception of adopting mobile learning into her future teaching*] whether most or majority of my learners will have access to mobile devices which are able to download all necessary apps that are needed when it comes to mobile learning” and “there are times when the task or the Internet connection might frustrate you and it's tempting to give up”. They also recommended that preparing the technological tool and internet connection in advance will make the lesson shorter “installing the application before time [session] and internet

[connectivity] problems did make the lesson longer". While some appreciated their experiences of connectivity and accessibility to mobile learning context "I should start exposing myself more to different kinds of teaching applications that the internet offers". Therefore, the formulated design principle from this cycle and implemented in Cycle Two is: *Create an authentic mobile-mediated learning context where pre-service teachers have access with a mobile device.*

Design guideline 2: Provide Authentic Tasks

Session two, three and four demonstrated how participants were engaged in mobile-mediated learning experience in a real-world setting. Participants showed commitment to the construction of mobile-mediated learning theory. Therefore, this design guideline allowed sandpit and supportive mobile-mediated learning environment that was fun and relevant to pre-services teachers' subject specializations as well as linked to their foreknowledge. This was evident when all participants wrote on the progress report chat that the sessions were fun, enjoyable and that they are willing to integrate it in their future pedagogical practices: "the Padlet is really a fun way of learning" and "it enhances learning, my learners will enjoy using it". As aforementioned, the design principle that emerged from this session and implemented in Cycle Two is: *provide time for pre-service teachers to explore the features and affordance of the mobile technologies to mediate authentic learning.*

Design guideline 3: Multiple roles and perspectives

Session Three allowed pre-service teachers to model pedagogical use of different technological tools such as Padlet, YouTube channels etc. in their specialized subject and development of ontological shifts, both for technological tools and pedagogical support. Pre-service teachers pointed out on the post-evaluation survey that they learnt multiple skills and knowledge and specified what worked and what didn't work out during the first cycle of M-MLI. They also suggested that "all students that are pursuing their studies in education to be trained on how to integrate ICT [mobile devices] in all their lessons. Therefore, this design principle offers a suggestion that multiple activities and learning experiences are essential for mobile-mediated learning. Hence the design principle from this element that was implemented in Cycle two is: *Engage pre-service teachers in multiple mobile-mediated learning activities to consume and produce.*

Design guideline 4: Support collaborative construction of knowledge

Session Four allowed collaborative peer learning to construct knowledge with the assistance of peer support and educator (researcher) as a mentor or scaffolder participation in peer learning. This design principle also requires educators to model how technological tools are used in pedagogy to the pre-service teachers. For example, participants commented on the benefits they gained from interacting and getting assistance from each other's as indicated by one participant that "I came to understand that teamwork is the key to success, and I learnt how to be a critical thinker. It's becoming tough but together with my colleagues we can make it possible". The essential point is that if pre-service teachers are engaged in dialogue with peers and have collective abilities, it can help them to achieve the complex authentic tasks with minimal support from the educator. As a result, pre-service teachers will become active participants in their own learning and interact to learn from each other's. However, monitoring and direction to guide the pre-service teachers are still required from the educators to successful complete complex tasks. Hence, the formulated design principle implemented in Cycle Two is: *provide an opportunity for pre-service teachers to use mobile-mediated learning collaboratively.*

Design guideline 5: Promote reflection to enable abstraction to be formed

Session Five, participants reflected and contrast their mobile-mediated learning experiences, ideas, and perspectives. Pre-service teachers admitted to the benefits of mobile learning and appreciated its potential to create transformative learning using mobile devices. This was proven from the post-evaluation survey that they completed, and they have indicated how they have enjoyed, gained new knowledges and skill about mobile-mediated learning. The use of mobile devices as mediating tools for teaching and learning was reported by pre-service teachers to fundamentally enhance and transform learning. For instance, some participants reflected: "it [Padlet] enhances learning and it is also another way of integrating technology in the classroom" and "because it enhances learning. Learners will enjoy using it". To this end, the affordance of the technological tools and elements of authentic mobile-mediated learning is crucial in facilitating the development of successful and engaging learning activities. Henceforth, the design principle from this session and implemented in Cycle Two is: *enable pre-service teachers to reflect on the mobile-mediated learning experience.*

Table 8.5 below is a summary of the initial design guidelines which were implemented in M-MLI cycle and how the emerged themes from the findings informed the formulated design principles that are implemented in M-MLI Cycle Two (see Chapter Nine).

Table 8.5

Iterative Cycle One of the M-MLI summary of the findings

Initial design guidelines	Formulated design principles
Provide authentic contexts that reflect the way the knowledge will be used in real-life	Create an authentic mobile-mediated learning context were pre-service teachers have **access** and with a **mobile device.**
Provide Authentic Tasks	Provide time for pre-service teachers **to explore** the features and affordance of the mobile technologies to mediate authentic learning.
Multiple roles and perspectives	Engage pre-service teachers in **multiple** mobile-mediated learning **activities** to consume and produce knowledge.
Support collaborative construction of knowledge	Provide an opportunity for pre-service teachers to use mobile-mediated learning **collaboratively.**
Promote reflection to enable abstraction to be informed	Enable pre-service teachers to **reflect** on the mobile-mediated learning experience.

8.5 Chapter Summary

This chapter presented findings from the M-MLI Cycle One indicating the testing of the design guidelines developed in chapter seven which the intervention was operating. From the findings of the M-MLI Cycle One of M-MLI, the design principles elicited from Cycle One that has a potential to influence practice of mobile learning among pre-service teacher have emerged. The chapter concluded by documenting the lessons learnt and recommendations to inform the second implementation of the M-MLI design solution in chapter nine. The next chapter nine will present the implementation and analysis of the design principles derived from Cycle One of M-MLI to further guide the design, implementation, evaluation, and analysis of mobile-mediated authentic learning design solution.

CHAPTER 9: IMPLEMENTATION OF THE ITERATIVE CYCLES OF MOBILE-MEDIATED LEARNING INTERVENTION (CYCLE TWO) *(DBR PHASE THREE)*

9.1 Chapter Overview

A typical Design-Based Research (DBR) study requires at least two or more iterative cycles of testing and refinement of the design solution where after every implementation and evaluation of the intervention, changes are made to the design principles. This is essential to enhance the design solution to address the research problem and based on the findings go on to implement innovations into lessons repeatedly (see Chapter five). Having stated that, this chapter draws on the findings of the second iteration of the M-MLI cycle, which follows the first iterative cycle of implementation presented in chapter eight. The chapter is structured according to the DBR approach. Firstly, a description of the formulated design guidelines of authentic learning and its modification to the design principles is presented. As such, the enactment of the second iteration was guided by the design principles that emerged from the design guidelines of authentic learning (Cycle One) which were modified to strengthen the design of the learning solution of this study (see Table 9.1). Secondly, following the structure of Cycle One of iteration in chapter eight, this chapter similarly presents the demographic background of participants; procedure of setting up an authentic e-learning context; presentation of data collection; and analysis of M-MLI iterative Cycle Two. The chapter concludes by recommending the design solution for iterative Cycle Three aimed at revising and finalizing the design principles of M-MLI for pre-service teachers.

9.2 Modification of initial design guidelines and procedural tasks for mobile-mediated learning intervention Cycle Two

Table 9.1 depicts the modification and transition of the initial design guidelines to the formulated design principles of M-MLI for pre-service teachers. The initial design guidelines for authentic learning that were implemented in Cycle One of M-MLI provided further opportunities to develop design principles, following the prerequisite of the DBR approach of testing and refinement of design principles. By doing so, after the implementation and evaluation of Cycle One of M-MLI, the initial design guidelines were refined and strengthened under the following scenarios: (a) the design guidelines of authentic learning as recommended by Herrington et al., (2010) are generic (see Chapter Seven) and do not incorporate the component of mobile learning. For this reason, the design guidelines of authentic learning were renamed and customized for

mobile-mediated learning with the rationale to integrate the concepts that are used to address the research problem and research questions of this study (see Chapter One); (b) M-MLI Cycle One finding and feedback analysis (see Chapter Eight, section 8.4) were used to redesign and improve the design solution that served as the foundation for M-MLI iterative Cycle Two implementations. This was substantial for two reasons: Firstly, the formulated design principles were framed based on the identified issues that enabled or constrained the success of M-MLI Cycle One among the pre-service teachers (participants). A review of this evidence enabled changes to be made to the design learning solution to strengthen it (see Herrington et al., 2010). Secondly, based on the DBR process, results from the previous cycle enabled the enunciation of the pedagogical and practical requirements for M-MLI Cycle Two. This was significant as it allowed the adjustments and improvements to learning design to be made between implementations of interventions so that the emphasis remained on finding the best approach to present mobile learning in the pedagogical context.

Correspondingly, following the setting of the real-life learning environment to enable pre-service teachers to reflect and mediate learning through emerging mobile devices (see Chapter Seven), non-linear navigation authentic learning activities were designed for iterative Cycle Two. This was essential to enable reflection and evaluation of mobile learning experiences following the formulated design principles of authentic learning, which guided the implementation of M-MLI Cycle Two. Furthermore, to effectively implement Cycle Two of M-MLI after the DBR approach, the personal learning environment (PLE) was also set in a similar context as that of the previous iterative Cycle One (see Table 7.1 and Figure 7.2 in Chapter Seven), but the process of authentic learning activities was modified to respond to the formulated design principles of M-MLI as shown in table 9.1.

From Table 9.1, a learning environment for the implementation of the second iterative cycle of M-MLI was designed. The authentic learning activities were a blend of pedagogical strategies that included: (a) completion of individual (participant) authentic tasks whenever and wherever participants were mobile; (b) exploration of the affordances and features of the technological tool used; (c) engagement in multiple tasks to consume and produce knowledge; (d) engagement in collaborative tasks; and (e) reflection on authentic learning tasks. These authentic tasks were designed to address the formulated design principles for M-MLI.

Table 9.1

Depict the initial design guidelines to formulated design principles and procedural authentic tasks for M-MLI Cycle Two

Initial design guidelines	Formulated design principles	Process of authentic learning activities for Cycle Two
Provide authentic contexts that reflect the way the knowledge will be used in real-life	Create an authentic mobile-mediated learning context were pre-service teachers have **access** and with a **mobile device**	***The Researcher:*** - Ensure Participants have access to WiFi/data bundles for internet access with a mobile device. - Invite participants from Cycle One to create a WhatsApp group for Cycle Two. - Invite participants to a virtual workshop via WhatsApp. - Allocate anonymity codes for new participants (they were not part of Cycle One). - Invite participants to install the Padlet on their mobile devices from Google Play Store or Apple Store - Post the consent form and pre-evaluation questionnaire to Padlet. - Introduces and explains the process, methods, timeframe, and technological tool/s of the mobile-mediated learning experience (Cycle Two) during the virtual workshop (using Zoom). ***The Participants:*** - Introduce themselves (Five participants from Cycle One and Three new participants). - Install Padlet on their mobile devices (new participants) from Google Play Store or Apple Store before the session. - Sign a consent form and complete a pre-evaluation questionnaire on a Padlet. - Familiarize themselves with the learning environment (Padlet) during the workshop.
Provide Authentic Tasks	Provide time for pre-service teachers **to explore** the features and affordance of the mobile technologies to mediate authentic learning	***The Researcher:*** - Invite participants to explore the features and affordances of Padlet. - Invite participants to create a video to explain and demonstrate the use of any two Padlet features. (e.g., how to embed pictures and videos, how to create links, how to create voice recorders, how to change colours, how to create your own Padlet, how to post YouTube videos, how to use Spotify, how to attach documents and files, etc.) - Develop and upload a Progress Report Journal (PRJ) to the Padlet wall via Google Docs. - Establish action learning sets and models through the use of Padlet features.

		The Participants: - Explore the features and benefits of educational technological tool(s) (Padlet). - Develop a tutorial (video or PPT) on how to use any two features of Padlet and post it on the wall. - Review each other's videos and comment - Complete the PRJ for sessions 1 and 2
Multiple roles and perspectives	Engage pre-service teachers in **multiple** mobile-mediated learning **activities** to consume and produce knowledge	***The Researcher:*** - Create and post a sample Google site called M-MLI Cycle Two (to serve as a model for the authentic task 3). - Post the sample website link to the Padlet for participants to access Task 3. - Invite participants to develop their own websites for their subject specialization and upload the teaching materials to their websites. - Demonstrate and scaffold the task. ***The Participants:*** - Create websites for their specialized subjects using Google Sites. - Populate their website by adding teaching material for the topic chosen from their school subject syllabus. - Post their website links on the Padlet wall for others to access them. - Blend mobile technologies with other mobile applications to construct knowledge - Participate in peer assessment - Complete the PRJ for Session Three.
Support collaborative construction of knowledge	Provide an opportunity for pre-service teachers to use mobile-mediated learning **collaboratively**	***The Researcher:*** - Allow for collaboration through peer discussion and with the researcher. - Use a think-pair-share activity. - Invite all students to comment on each other's task websites (advise on how to improve them) that were posted on the Padlet wall from the previous session. ***The Participants:*** - Comment on each other's websites and share more ideas on how to populate their websites via Padlet. - Reflect on collaborative knowledge construction - Complete the PRJ for Session Four.
Promote reflection to enable abstraction to be informed	Enable pre-service teachers to **reflect** on the mobile-mediated learning experience	***The Researcher*** - Invite participants from Cycle One to develop a post-evaluation questionnaire for Cycle Two of mobile-mediated learning and Padlet experiences. - Invite participants (new participants) to

		complete the evaluation questionnaire to reflect on the process of mobile mediated learning experiences for Cycle Two. ***The Participants:*** Cycle One participants create a post-evaluation questionnaire for the new participant to complete. Reflection from Cycle One, on how the post-evaluation questionnaire was developed Complete the post-evaluation questionnaire, sharing their experiences and challenges from the M-MLI Cycle Two. Complete PRJ to reflect on Cycle Two.

The researcher and participants worked collaboratively to complete each of the authentic learning activities set for Cycle Two of M-MLI via Padlet. The M-MLI iterative cycle took place from November 2021 to 20 December 2021. The proceeding sections present a description of the participants, data collection, and data analysis for Cycle Two of M-MLI.

9.3 Participants of Mobile-Mediated Learning Intervention (M-MLI) (Cycle Two)

The third-year pre-service teachers doing bachelor's degrees in secondary education from IUM were again invited to participate in this cycle. However, some of the participants from M-MLI Cycle One were also invited to participate in Cycle Two. The needs of participants from Cycle One assumed that they were familiar with the mobile-mediated learning environment using Padlet from the previous/first cycle, whereas they could be mediators and scaffolders of M-MLI Cycle Two. This is linked to the notion of this research; that is, if pre-service teachers undergo training in learning and instruction that is mediated via mobile devices, a future teacher will be able to reflect on the pedagogical aspects of how mobile devices can be effectively used as a mode of teaching and learning. As a result, participants from Cycle One were given the opportunity to revisit their previous experience with Padlet to reflect on and model the knowledge and skills they gained during Cycle One of M-MLI. This also provided me with an opportunity to observe and evaluate whether there was a shift in participants' dispositions or consciousness towards mobile learning, which enabled the fusion of horizons (see Chapter Five) to unfold.

In total, eight (8) pre-service teachers agreed to participate in Cycle Two, which consists of five (5) participants from Cycle One: three (3) commerce, one (1) language,

one (1) social science and three (3) new participants: one (1) commerce, one (1) science, and one (1) social science. I could not accommodate more than 8 participants per cycle as this research adopted Revan's pedagogical practice of AL theory (see Chapter Six) where a small group of 4 to 8 students is recommended for an action learning intervention. Thus, participants from Cycle One each submitted only one name of a new participant from their class group who is doing the same school subject specialization to be part of Cycle Two. There was no recommended new participant from the language field of study as no one submitted an intention to participate in M-MLI Cycle Two. It was, however, easier for me to encourage participants from the commerce field of specialization as I was their lecturer for teaching methods of commerce subjects such as accounting, economics, business studies, and entrepreneurship, which was one of the requirements to participate in this research. Hence, four participants in M-MLI Cycle Two are from the commerce field of specialization (see Table 9.2).

The selection process of participants for M-MLI Cycle Two was done as follows: firstly, I invited at least four participants (doing different school subject specializations) from Cycle One who was willing to participate again in Cycle Two to submit their names to me. Secondly, those who agreed to participate in Cycle Two were requested to invite other third-year pre-service teachers (who were not part of MM-LI Cycle Two) from IUM doing secondary education in 2021 to join Cycle Two of M-MLI. I later encouraged the selected participants from Cycle One to create a WhatsApp group named M-MLI Cycle Two and add the new participants to the group. The first interaction with all the participants for M-MLI Cycle Two was done on the WhatsApp group (on October 19, 2021), which was used as the fastest means of communication since all participants were frequent users of WhatsApp, as narrated in chapter five. I welcomed all the participants to the group and explained the aim of the group, or M-MLI Cycle Two. During this process, I created and allocated codes for the new participants as the participants from Cycle One retained their codes from Cycle One (Table 9.2).

The reason for earmarking the participants with codes was to maintain anonymity throughout the research and to correspondingly guide the analysis of the data. It was also significant for the participants from Cycle One to retain the same code as it allowed me to trace how their previous mobile-mediated learning experiences (past, Cycle One) impacted their new mobile-mediated experiences (present, Cycle Two). Here, I

reminded myself of these questions: was there a shift in disposition toward mobile-mediated learning experiences among pre-service teachers' transition from Cycle One to Cycle Two of M-MLI? Were they able to facilitate and scaffold others (new participants) during the M-MLI Cycle Two in reflection on their past experiences from Cycle One? Are they showing the potential to integrate the same skill or practice into their future teaching? My questions concurred with Gadamer's postulation that when a person undergoes a personal learning experience, it creates a radical shift in their consciousness and, after this transformation, they cannot go back to the previous views held (see McManus Holroyd, 2007). As per the aforementioned, the new participant codes were different from the participants from Cycle One, as I added an "N" at the beginning, which stood for "New", hence the three new participants, was coded as NST1, NST2 and NST3.

Table 9.2

A summary of participants' background information for M-MLI Cycle Two

Student Code	Gender	Field of specialization and Year of study	Mobile device owned	Experience with Padlet before Yes/No	List of Application/website used before
ST2	M	Languages (Fourth Year) (Participant from cycle one)	Tablet	Yes	WhatsApp, Telegram, Facebook, Google Meets, Zoom
ST5	F	Commerce (Third Year) (Participant from cycle one)	Smartphone and Laptop	Yes	Google search and Chrome, WhatsApp
ST6	F	Commerce (Third Year) (Participant from cycle one)	Smartphone	Yes	Google search and Chrome, WhatsApp
ST7	M	Social Science (Third Year) (Participant from cycle one)	Smartphone	Yes	Google Search, Emails, WhatsApp. Google scholar, Quara
ST8	M	Commerce (Fourth year) (Participant from cycle one)	Smartphone	Yes	Chrome, YouTube, Personal blog, News websites. Online portfolio. Educational websites

NST1	F	Commerce (Third Year) (New participants)	Smartphone	No	Google
NST2	F	Social Sciences (Third Year) (New participants)	Tablet	No	Google, Facebook, WhatsApp
NST3	F	Science (Third Year) (New participants	Smartphone	No	No response

Following table 9.2, five (5) participants were female, while three (3) participants were male. In contrast, two participants were in their fourth year, while six participants were in their third year of studies. I could not accommodate any new participants from the fourth year of study as M-MLI Cycle Two was done towards the end of the year 2021 and, considering that it was their final year at IUM, it would not be possible for them to participate in M-MLI Cycle Three, which took place in the year 2022 if, need be.

Furthermore, the mobile devices owned by participants were as follows: five (5) participants owned a mobile smartphone, two (2) owned a tablet and one (1) owned both a smartphone and a laptop.

9.4 Procedures for setting up an authentic e-learning context for M-MLI Cycle Two

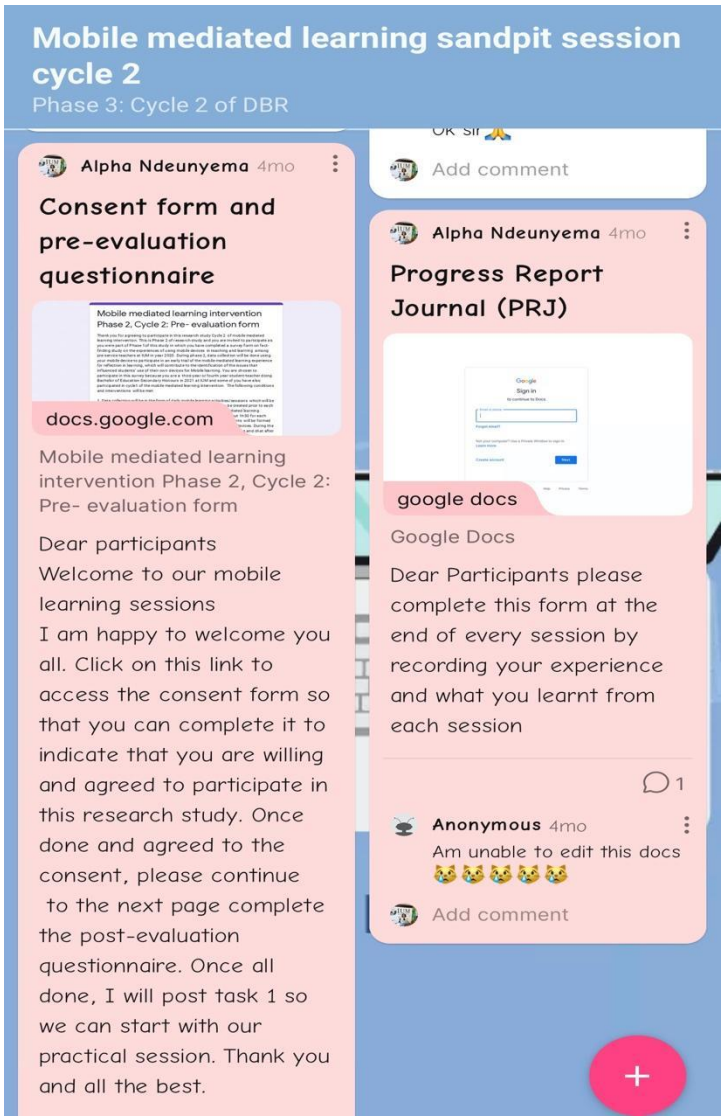
Even though the participants were selected and welcomed to the M-MLI Cycle Two during the month of October 2021, I was not able to implement the intervention sessions during that time. This was due to the COVID-19 pandemic, which affected my health as well as a few members of my family and colleagues who succumbed to COVID-19. It was for this reason that the actual preparation and implementation for M-MLI Cycle Two sessions was rescheduled to start on November 20, 2022, upon my recovery. However, because pre-service teachers (students) were busy with their end-of-year exams, this was not an appropriate time. Thus, we have agreed to continue with Cycle Two of M-MLI sessions after their examination, which was on December 7, 2021.

Cycle Two of M-MLI findings revealed that preparing the technological tool and connecting to the internet ahead of time is critical prior to the design learning session. Having this in mind, I decided to conduct an orientation session for M-MLI Cycle Two

before the actual practical design learning. Using a WhatsApp group that was created by the participants from Cycle One of M-MLI, I have invited all participants to join the orientation webinar by sharing a Zoom link to the group a day before (6 December 2021). The purpose of the orientation session was premeditated to provide participants with an in-depth understanding of their roles during the intervention as well as to induct them to the Padlet wall (especially new participants) for M-MLI Cycle Two. Prior to the session, I created my Padlet wall named "Mobile-Mediated Leaning Intervention Cycle Two". Correspondingly, I bought data bundles for all the participants to ensure that each participant had access to the internets. I also invited new participants to install the Padlet app on their mobile devices prior to the webinar.

Figure 9.1

A snapshot from Padlet for setting up an authentic context for M-MLI Cycle Two



The orientation session was conducted on the scheduled date and lasted for 43 minutes. All participants joined the webinar and participated actively until the end without any glitches. During the session, I initially asked each participant to introduce themselves. After their self-introduction, I reminded them of the anonymity codes that they must use throughout the intervention. I then shared a link to the WhatsApp group so that they could access my Padlet wall for M-MLI Cycle Two easily. This was also done because I was having trouble sharing my screen. Prior to the webinar, I posted in advance a welcoming remark, consent form, pre-evaluation questionnaire, and the PRJ to the Padlet wall, which I explained and informed them to complete after the session (see Figure 9.1).

As a researcher and an educator, I later explained the aims, process, and procedures of M-MLI Cycle Two to the participants, such as using their codes when posting on the Padlet wall, the number of expected sessions and tasks to be completed, the time frame, communication platform, role of new participants, roles of participants from Cycle One, how to complete a PRJ form, etc. Subsequently, I have invited the participants from Cycle One to reflect and share their experiences, the types of tasks they completed, and the skills they acquired from Cycle One with the new participants. This step alludes to the HLE theory that the present can only be understood in the context of the past. Hence, participants from Cycle One were given a chance to reflect on their previous knowledge and experiences with mobile-mediated authentic learning from Cycle One. At the end of the session, participants were also given a chance to ask questions and comment.

Following the setting of an authentic context for M-MLI Cycle Two via webinar, the proceeding session presents the data collection and analysis for each authentic task session.

9.5 Data Collection and Analysis of M-MLI Cycle Two

Following the data collection procedures/instruments and analysis of findings from Cycle One of M-MLI, for instance, pre-and post-evaluation questionnaires, chats/transcripts from the Padlet wall, participants' artefacts (including websites, post-evaluation questionnaires, teaching notes), peer comments, observation of participants' engagement, and the PRJ, the data collected during M-MLI Cycle One is akin to that of Cycle One. Data was collected from five sessions, and each session was intended to

test and implement the formulated design principles as described in the preceding sections. At this point, it is worth noting that two participants have withdrawn from the intervention as of the second session. Their reason was that they went on holiday to the villages in rural areas, and they indicated that they were struggling with the mobile network coverage. Hence, they were unable to complete Cycle Two tasks as they required access to the internet and mobile network coverage. These participants are ST5 and NST3. Notwithstanding the drawbacks, the remaining participants managed to participate in all sessions up to the last day. Each session was posted on the Padlet wall, and participants were given at least two to three days to complete a task.

As noted earlier in chapter eight, WhatsApp (a very popular mobile instant messaging app among IUM students) was used to post notifications, updates, and comments, and to check whether there was a new post or changes made on a Padlet. I acknowledged Gachago et al.,'s (2015) affirmation that WhatsApp has the ability to improve immediacy and connectedness across formal, informal, and open distance learning environments, enabling students to reflect more easily while also enhancing their control and ownership of their learning. Thus, I continued using WhatsApp as a supplementary technological tool which assisted me in easily communicating the authentic learning tasks of M-MLI with participants. It must be noted that all M-MLI Cycle Two authentic tasks were conducted on the Padlet wall, with WhatsApp used primarily for immediate notifications and announcements.

In contrast, the hermeneutic cycle-driven analysis and evaluation of M-MLI Cycle Two findings were again done according to the formulated design principles of mobile-mediated authentic learning. The proceeding session presents the analysis for each session of the authentic M-MLI, Cycle Two.

9.5.1 Session One: Create an authentic mobile-mediated learning context were pre-service teachers have access with a mobile device

Following the M-MLI Cycle Two orientation webinar, Session One focused on using a Padlet wall to create an authentic context for the M-MLI, Cycle Two. To create an authentic context for M-MLI Cycle Two, the following tasks were given to the participants:

Firstly, participants were encouraged to access the Padlet wall that I created for the M-MLI Cycle Two by clicking on the link that I posted on the WhatsApp group https://padlet.com/a_ndeunyema/19ql3kqiyee27q4t (this was done during the orientation session; see section 9.3 above). Participants were then encouraged to complete the consent and pre-evaluation Google forms that were already posted on the Padlet wall. The rationale for a pre-evaluation questionnaire was significant for two reasons: (a) to encourage M-MLI Cycle One participant to reflect on previous M-MLI experiences (past), and (b) to encourage new participants to reflect on their historical perceptions of mobile learning (past). This view is in support of Gadamer's argument that we must reflect and revisit our past experiences (prejudice) or understanding and align it with the present experience to create new understanding and meanings (Paul, 2012). Hence, I initially address participants' past experiences before they were engaged in the present experiences of M-MLI Cycle Two. *Secondly,* having participants from Cycle One with experiences of M-MLI, I thought of inviting them to develop an ice-breaking authentic task like the one that they completed in Cycle One and post it to the Padlet wall. I found this very significant for me to observe whether they can still recall and reflect on what they learnt/experienced from Cycle One and how to implement it in their own context. *Finally*, participants were asked to complete a PRJ to reflect on Session One of the M-MLI. My role was to facilitate and provide guidance/scaffolding when on demand. While participants from Cycle One were transformed to be authentic task creators and scaffolded new participants, which triggered their active participation in learning.

Analysis from the pre-evaluation questionnaires (questions 8 to 11 respectively) (see Appendix D) shows that five (5) participants have used Padlet before while three (3) indicated that they have never done so. Participants who were part of M-MLI Cycle One clearly declared and acknowledged having pre-existing knowledge of Padlet. When asked to state the activities they did on a Padlet wall (question 9), participants from Cycle One reminisced about their M-MLI Cycle One experiences. One participant (ST8) reflected:

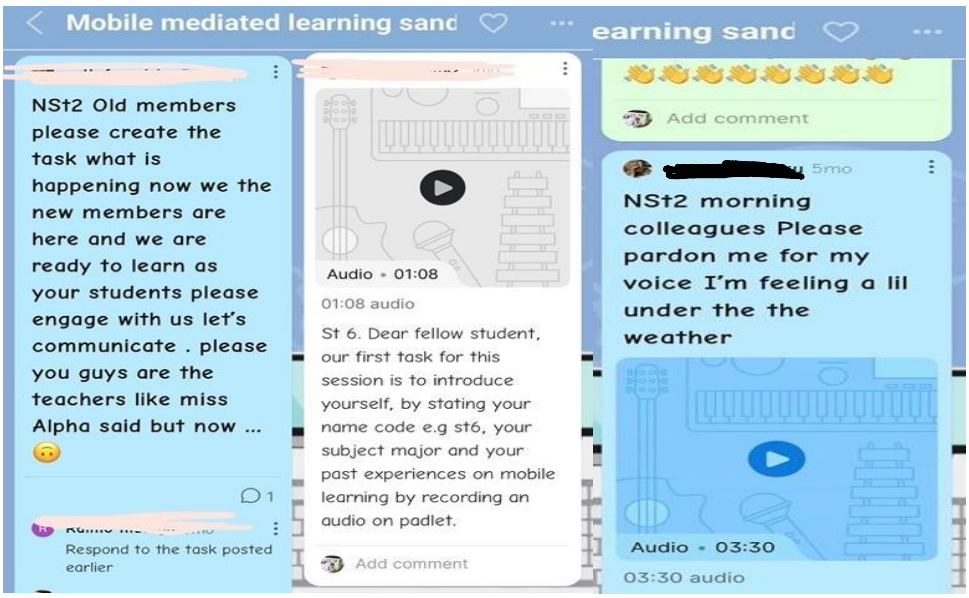
> *"The activities I did on the previous Padlet are as follows: first I learned that (referring to M-MLI Cycle One) a Padlet is an online notice board, where we as students can also chat, we did the online recorded lesson, we created links and also set up different questions, using Google form."*

Furthermore, participants were asked to rate the usefulness of mobile devices in learning (their studies) on a scale of not useful to very useful (question 10). Results from the pre-evaluation questionnaire affirmed that seven (7) out of eight (8) participants believed that mobile devices are very useful in their academic lives, while one (1) participant indicated that they are somehow useful. These findings affirmed the efficacy of mobile devices in teaching and learning, which corresponds with the results of the fact-finding study (see, Chapter Five). Following that logic, if participants have an affirmative attitude to the benefits of mobile devices on the academic ground, it could be the reason why they responded positively to mobile learning and the possibility of adoption in their future classrooms.

Since the primary purpose of authentic learning tasks is to acquire knowledge and skills through real-life experiences (see Herrington et al., 2010), participants from Cycle One of M-MLI revealed that they had acquired new knowledge and benefited from the intervention. This was evident when they created an authentic icebreaker activity (see Figure 9.2) that they designed and posted on the Padlet wall. It seems like being part of M-MLI Cycle One provided an opportunity for them to observe concrete examples of mobile-mediated learning pedagogical strategies. Hence, they are now applying it in their own context by initiating others to first introduce themselves on the Padlet, which could be informed by their pre-existing experiences/knowledge.

Figure 9.2

A snapshot from the Padlet for Session One of M-MLI Cycle Two



The comment of one participant (St2) as depicted in figure 9.2 below is pointing to the level of perceived ease of learning mediated through a mobile device (Yuan et al., 2021). During the time of M-MLI Cycle Two, a Padlet application was updated and improved to a new version which was different from Cycle One. For example, the Padlet icon was changed, new features and functionalities were added etc. hence, participants who were part of Cycle One felt that the Padlet application was different from the one that they had used before. Yuan et al., (2021) argued that If learners have fewer perceived challenges while using the application, they are less likely to become frustrated with it, and vice versa. This could be the reason why the participant posted emotional emojis (see extract from Padlet below) and not excitement.

Furthermore, the findings of this study also revealed that good internet access and mobile network coverage are the key requirements to facilitate the mobile learning process effectively (e.g. Yuan et al., 2021). This was confirmed when some participants were not responding promptly to the task, and their main reason was that they were out of mobile network coverage. This was also one of the reasons why two participants withdrew from the study (St5 and NSt3). However, given the benefits of mobile devices that enable participants to retrieve or complete tasks even when they were offline, outside of network coverage, or when their devices were turned off, they could contribute at anytime and anywhere regardless of context (Kearney et al., 2012; Kritzenberger, 2013). It is, for this reason, it was relevant for participants to be given two to three days to complete a task wherever they were (mobile) and at any time they had access.

Correspondingly, my observation of the participants' engagement on the Padlet revealed that the anytime-anywhere nature of the m-learning environment makes the learning process unpredictable at times (Kritzenberger, 2013). For instance, M-MLI Cycle Two was conducted when students were in a celebratory holiday mood and they were not as active as participants of Cycle One when the intervention was conducted

during semester 2 of their academic. My assumption, however, is that the social context (holiday/family time) that participants were in at the time of intervention, could be the reason why at times they took two to even four days to respond to the task.

It could be argued that the authentic context was created, and the personal learning environment was established while participants were mobile and had access. To cross-check these findings, a reflection of Session One on the PRJ (see Appendix F) revealed that due to lack of access, the two participants who withdrew from the study did not complete the journal. The remaining six participants completed the PRJ at end of the session which shows evidence that they were pleased and enjoyed the task.

During reflection, I was more interested in seeing how the new participants responded to Session One, and they post the following comments on the PRJ form as follows:

NSt1	*"It was fun during this session. Although, I was experiencing some constraints more specifically on how to utilize the Padlet app. I felt fortunate to be working with a helpful team. I'm thrilled to be embarking on this platform as this improved my technological skillset. As a new Padlet app user, I found this app to be very useful and educative. I learnt how to record audios just to mention a few".*
NSt2	*"This is my first experience with the Padlet app and I must say it's going great I also enjoyed doing the first task on Padlet such as how to comment on posts made, doing an audio recording were some of the first activities I had to do and I had fun exploring them because they are easy to understand and use".*

It is evident from the new participants' comments above that they embraced and found Padlet App useful and educative. They both mentioned that Padlet was fun and easy to use. Hence, they responded to the authenticity of mobile-mediated learning experiences favourably. This encapsulated the creation of an authentic context for M-MLI, Cycle Two. Thus, allow them to participate further in Session Two. The next section summarizes the findings of Session Two.

9.5.2 Session Two: Provide time for pre-service teachers to explore the features and affordance of the mobile technologies

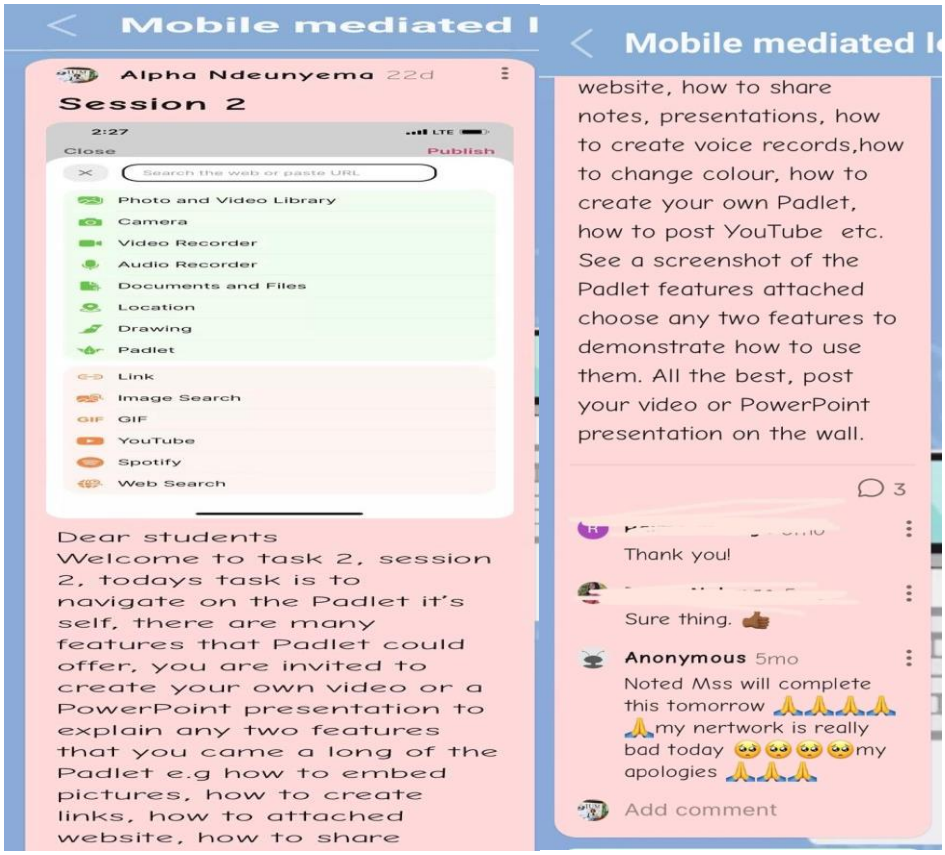
After all participants completed a PRJ form for Session One, the Session Two task was posted immediately (see Figure 9.3). This task was relevant to give participants an opportunity to explore the Padlet features and their functionality. Session Two required each participant to navigate through Padlet and develop a PowerPoint Presentation or a

videocast describing any two features of the Padlet. Padlet features as shown in figure 9.3 includes a camera, video/audio recorders, photo/video library, documents/files, location, drawing, Padlet, link, image search, GIF, YouTube, Spotify, and web search among others.

Participants' posts on the Padlet for Session Two revealed that they responded positively to this task (see Figures 9.3 and 9.4). However, none of the participants presented the features of the camera, photo/video library, location, drawing, link, image search, GIF, Spotify, and web search of the Padlet. Rather, participants' artefacts on the Padlet show that the new participants (NSt1 and NSt2) only shared videos from YouTube on how to create a Padlet and how to teach with Padlet. In contrast, participants from Cycle One (e.g., St8, St7, St6, and St4) developed their own videocast and PowerPoint presentation by demonstrating how to use features such as documents, videos, and audio uploads.

Figure 9.3

A snapshot from the Padlet for Session Two of M-MLI Cycle Two

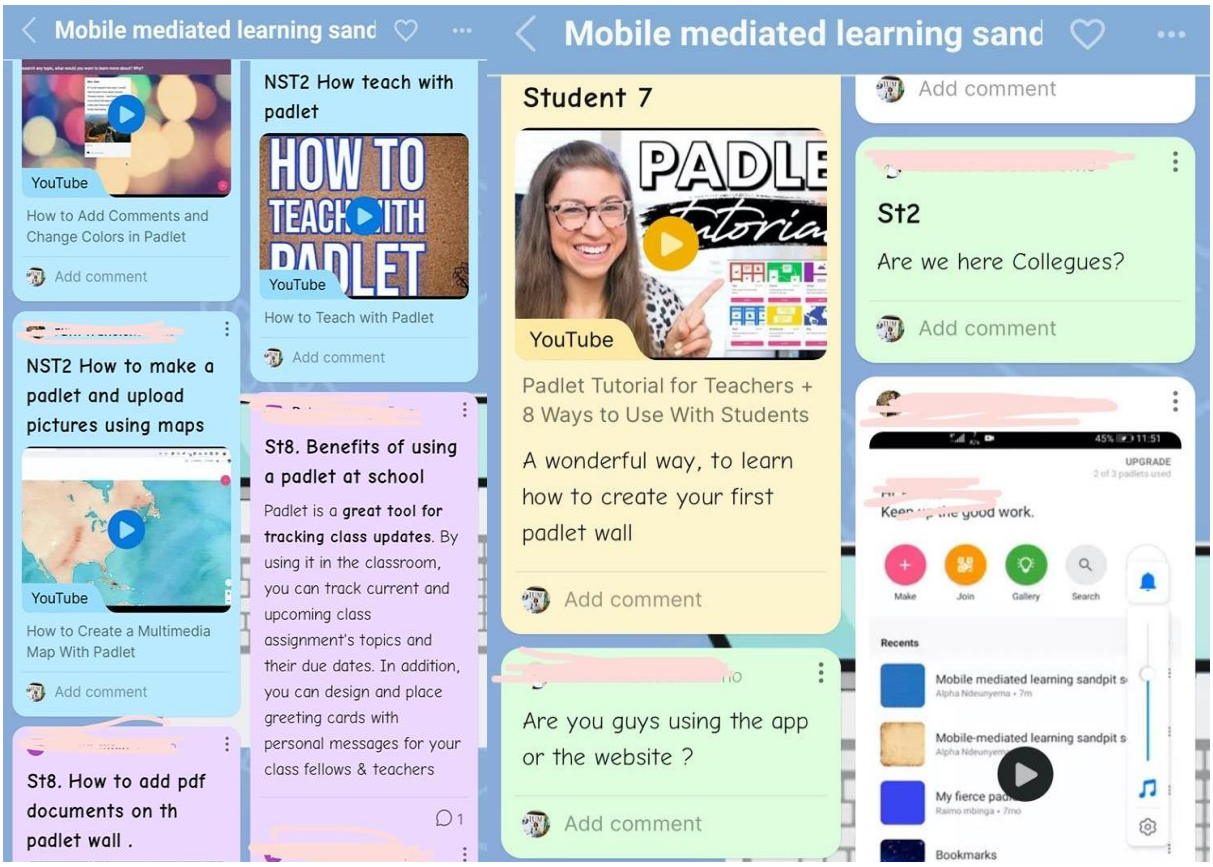


Subsequently, results from the fact-finding study (see Chapter Five) revealed that students were frequent users of WhatsApp which they use to share their academic notes, videos, and audio. Perhaps this could be the reason why participants only chose to present similar features of the Padlet.

Following my observation, for the proceeding sessions (sessions Three, and Four), I opted to develop authentic tasks that required participants to explore and use other features of Padlet (such as drawings, creating links, and web searches) so that they would embrace their affordances too. This aligns with Bower (2008), who advocates the creation of e-learning experiences that match task affordance requirements with the affordances provided by available technological tools. An affordance of a technology is the benefit or challenges that a technology brings to the learning task.

Figure 9.4

Session Two, extracted participants' artefacts on a Padlet for M-MLI Cycle Two



Furthermore, St6 indicated that she created her videocast using the X-recorder (the same screencast recorder that I introduced to them during M-MLI, Cycle One) to present the features of how to upload files to the Padlet. This finding alludes to the

never-ending dialogical rhetoric between the past and the present, as represented in the process of allocating meaning to the past via the lens of the present.

Subsequently, I further crisscrossed my observation and findings from the participants' artefacts on the Padlet wall with the findings extracted from the PRJ form. See below-extracted comments from the PRJ form for Session Two.

St2	*"The experience of getting to know how to make use of the features on Padlet was really a good one …. I learned a lot."*
St6	*"I love the fact that every time, we always learn something new on Padlet. Despite being introduced to the Padlet before, I was not aware of some features on the Padlet. Session Two helped me to learn more about certain features on the Padlet. This task was not so difficult."*
St7	*"Session two was not challenging, as it required us to explain features of any two features on Padlet via screen recording or presentation, ……I created a PowerPoint presentation."*
St8	*"Session Two, was easy for me, as I was already been introduced to Padlet before and I have been playing around with those features. Since I was introduced to Padlet, I have always been one who wants to learn more about this app. I didn't have any challenges while doing task 2."*
NSt1	*"Task 2 was quite a challenge. I honestly had no clue as to how to go about it. But I'm glad my team came to my rescue. I later figured out that teamwork is the fundamental key to progress. I was able to illustrate several features on the Padlet and even post videos on YouTube. This was one of the awesome experiences I have encountered and I'm elated."*
NSt2	*"Task 2 was not that easy to do, it took me time to compete because, I wanted to make a video recording and PowerPoint presentation but my smartphone did not support the app that one can use to make a screen recording video so it resulted in me just having to upload videos for the task that we were given, which was making a video explaining the different features on Padlet."*

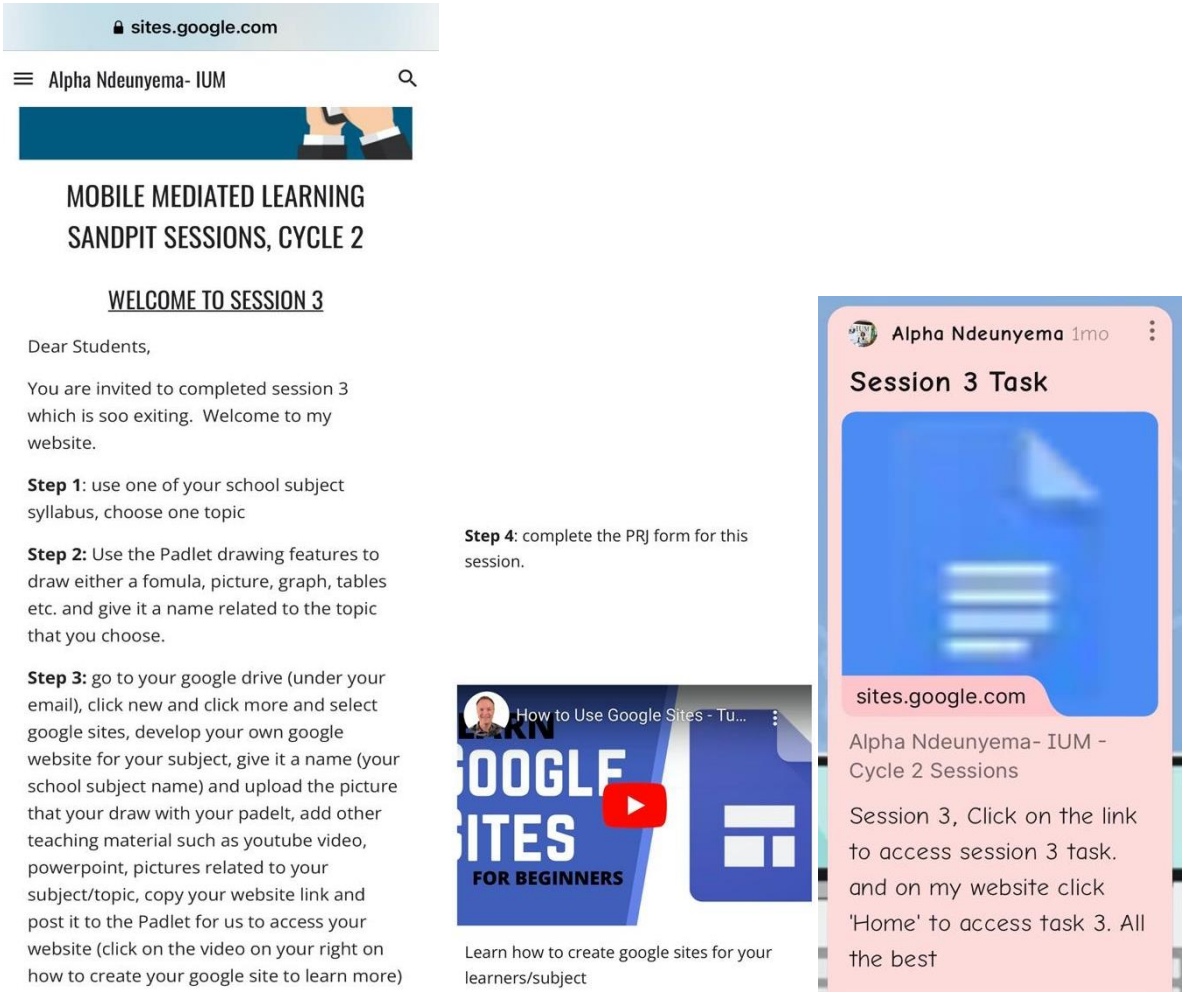
Reflection of Session Two as per sentiments shown above revealed that participants from Cycle One found the task very simple while new participants indicated that the task was quite challenging, thus, they only posted the YouTube videos. To this end, I argue that Session Two propelled the participants into exploring the features and affordances of Padlet and encouraged their self-reflection, developing their own learning and embracing the contributions of others. This is in line with Gadamer's philosophy, which advocates for a fusion of horizons in which the horizon of the present (Cycle Two) cannot be constructed without the horizon of the past (Cycle One) (Geanellos, 2000). That said, the following section encapsulates findings from Session Three.

9.5.3 Session Three: Engage pre-service teachers in multiple mobile-mediated learning activities

Session Three was created to encourage participants to explore different ways and techniques of using mobile devices to mediate learning. In support of this view, Herrington et al., (2010) argue that instead of students being exposed to a single perspective to examine a problem that is deemed to be inadequate, it is important for them to explore different perspectives on the different topics and subject areas to "crisscross" the learning environment repeatedly.

Figure 9.5

A snapshot from the Padlet for Session Three of M-MLI Cycle Two



At this point, multiple mobile-mediated learning activities were provided within the learning context in four distinctly different ways (see also Figure 9.5):

a) Using Google Site, the researcher developed a M-MLI Cycle Two website, uploaded a YouTube video describing how to do so, posted Session Three tasks, and published the website link to Padlet so that participants could access the activities

b) Participants were required to develop their own websites and so brought a unique approach to teaching and learning with mobile devices through Padlet
c) Participants were required to use the drawing feature of the Padlet to draw a picture, formula, graph, table, etc., for their webpage screensaver, bringing them to the point of using other features and functionality of the Padlet (responding to Session Two)
d) Students were required to upload teaching materials for any topic from their subject specialization syllabus to their developed websites to enable mobile-mediated learning perspective from different perspective and subject areas (see Figure 9.6 too).

Evidence from Session Three indicated that participants had started the process of practicing different mobile mediated learning activities, which enabled the multiple perspectives and approaches of learning using mobile devices as well as Padlet (to be specific). From the previous Session Two, it was assumed that participants valued the Padlet features that they were familiar with. It was a deliberate action to introduce an approach in Session Three that enabled them to start practicing other features of Padlet and learning with mobile devices, such as creating a website, creating a website link on the Padlet, using the drawing features of the Padlet, and using their subject majors to develop a mobile learning context. All these outrightly shaped the participation of pre-service teachers in multiple mobile-mediated learning activities.

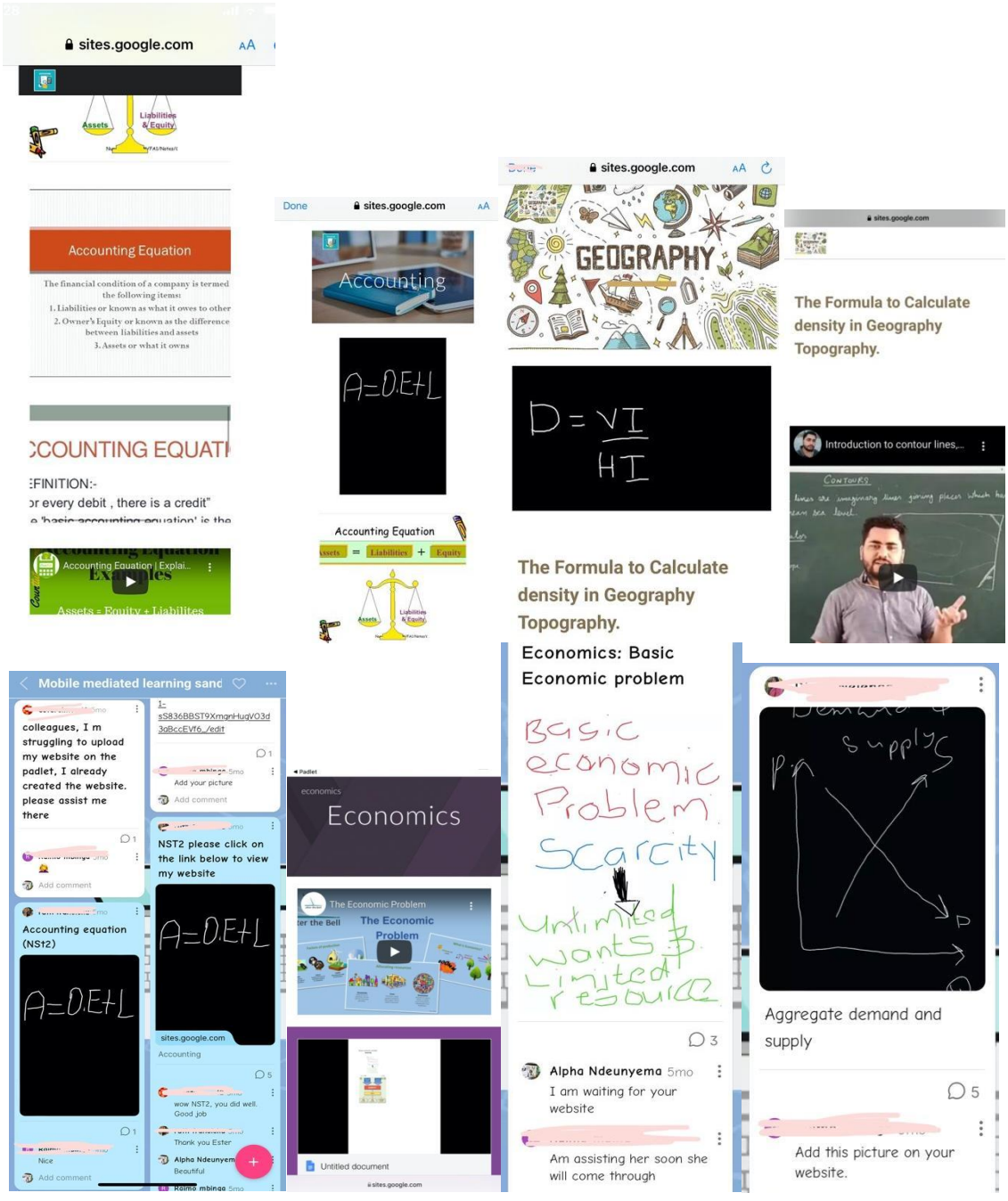
Accordingly, figure 9.6 below shows snapshot extracts from the participants' websites that they developed and posted on the Padlet wall. It was so impressive to observe that one of the new participants, NSt2, who is new to Padlet, was actively involved in this session and the first one to upload her website link to Padlet. She drew a picture named A=OE+L (see Figure 9.7), a formula from the accounting subject, uploaded the picture to her website, and she added Pdf notes as well as the YouTube videos explaining the topic chosen from her subject syllabus.

Subsequently, NSt1 posted first the picture that she drew with a Padlet, depicting the basic economic problem of scarcity and an arrow pointing to unlimited wants and limited resources (see Figure 9.6). Knowing that my role as a researcher during the intervention was to monitor participants' progress and provide guidance, I replied to NSt1's posted picture by saying I am waiting for your website. In response to my

question, St8 responded: "*I am assisting her* (referring to NSt1), *soon she will come through*" (see Figure 9.6). As a result, NSt1 posted her website link to the Padlet a day later. However, the picture that she drew was not uploaded to her website. Rather, she posted a picture from the internet named "economics" and a YouTube video titled "economic problem," as shown in figure 9.6. Other participants from Cycle One (St6, St7, and St8) also developed their websites, but St2 did not do this task as no post was done by him.

Figure 9.6

Extracted participants' artefacts from Session Three on a Padlet for M-MLI Cycle Two



Findings from the participants' artefacts show that their developed websites were somehow similar, as none of them made the picture that they drew with Padlet a website screensaver/profile picture. Rather, they used pictures from the internet, e.g., geography or accounting (see Figure 9.6), and they posted their own drawn pictures (which are also similar) depicting formulas such as A=OE+L and D+VI/HI on the website instead of making them profile pictures. They both merely posted YouTube videos and nothing else. The fact that NSt2 was the only one who utilized her photo as a website profile picture was intriguing. The fact that all participants did the same thing was most likely due to the collegial influence of my website, which displayed a comparable context. The insight I acquired here was that it was necessary to model and advise participants on how to create various types of the unique website content, such as different pages, different structures, layouts, and uploading various types of instructional materials, among other things. Nonetheless, participants were, without a doubt, enthusiastically involved and engaged in various M-MLI activities.

To corroborate these findings, reflective comments on the PRJ from Session Three show how participants engaged and cooperated with one another to forge their way into this similar practice.

St6	*"This session was a challenge for me. Firstly, due to my current location, the internet connection is bad and I find it difficult to complete my tasks.* *I thank my colleague, who came to aid me in creating my website. This task was a challenge hence I didn't know how to place my created pictures on the website."*
St7	*"Today's session was a little bit challenging but after watching the video that Miss uploaded on her website, it helped me create my own website, step by step."*
St8	*"Session Three was so interesting and managed to complete my task on time. Therefore, I have enjoyed taking part in this task.in addition, I learned to seek assistance from others when things are becoming challenging."*
NSt1	*"The task was a bit challenging but I managed to create my own website. Thanks to my friend who assisted me with this task. I'm still learning how to go about everything so that I fully comprehend my tasks. I'm having fun and learning a lot of things with the Padlet."*
NSt2	*"These session tasks were really fun to complete. I learned how to create my own website by watching a video that Miss posted and how to add different content and it had to include one of my specialization subjects. It's really a nice journey of learning using technology."*

The reflective responses of Session Three above suggest that participants appreciated their experiences of developing their own website. It is also evidence that participants reflect freely on their website development experiences, attend to feelings (such as having fun, enjoying etc.), and re-evaluate their learning experiences. The findings mirrored my own observation that participants work collaboratively to complete the task. Hence, their artefacts are the same. My argument, therefore, is that scaffolding and support of mobile learning should be provided at the metacognitive level instead of capitulation through the provision of detailed step-by-step guidance in the early stages of completing the task (see Herrington et al., 2014).

9.5.4 Session Four: Provide an opportunity for pre-service teachers to use mobile-mediated learning collaboratively

Following the formulated design principles for a M-MLI as illuminated in the preceding sections, Session Four responds to the notion of engaging pre-service teachers in collaborative authentic tasks. To provide a learning environment that would promote collaboration among the participants, Session Four was predominantly designed with an authentic activity to enable them to engage with each other. Participants were asked to access and comment on how to improve each other's websites that they designed in Session Three (see Figure 9.7 below).

The findings from Session Three (previous section) clearly demonstrated how participants acknowledged the support they received from others to complete the task. Accordingly, the Session Four authentic tasks were designed to promote and further support peer engagement, eliminate instructor domination, and assure participants ownership of their learning (e.g. Rambe & Bere, 2013). Subsequently, figure 9.7 depicts how authentic context fostered collaboration in Session Four. It also demonstrates that the task was embraced by the participants, and enabled information sharing and knowledge construction. In support of this view, Kearney et al., (2012) argue that m-learners can benefit from a high level of collaboration by creating strong connections to other learners and resources via a mobile device.

Even though all participants reacted to the collaborative authentic task, many simply commented on each other's website appearances and structures, such as "*I like your website"; "you did great*"; *"I like what I am seeing";* and "*waaw you did well",* these

captions were somehow not sufficient to demonstrate the efficacy of collaboration, as no adjustments or improvements were made to their website artefacts.

Figure 9.7

A snapshot from the Padlet for Session Four of M-MLI Cycle Two

Hence, peer review was not critically done. Nevertheless, one participant (St7) commented well on one of the peer websites:

> *"I would like to recommend that you have a welcoming message on your website, as it would make the learner feel more at home, furthermore, I would like also to recommend that you provide contact information such as your work number and your email address"*

This comment encapsulates the view that each person brings individual experiences and learning to the situation and each participant is capable of influencing others to the completion of the task in a unique way as distinguished by Herrington and Oliver (2000). My assumption here is that perhaps participants were comparing their developed webpage (own understanding) with others and identifying the similarities and differences. That could be the reason why he had given himself a new perspective and ideas on how to develop a website. In this sense, the findings do not rule out a potentially powerful and effective scaffolding by the instructor (researcher), which might limit the role of collaboration among the participants to be fully investigated in Cycle Three, this was improved and expanded.

Participants' comments on the PRJ form substantiate these findings. It is important to note that only three out of six participants provided a reflection on Session Four. St2, NSt1 and NSt2 did not comment on the PRJ even though they commented on others' websites. It seemed that the authenticity of the collaborative learning environment was not challenging enough during this session, as participants perceived the activity to be relatively straightforward and not demanding. Hence, some participants could not share their experiences and knowledge acquired from this session. The extracted comments from the PRJ form (see Appendix F) below are evident:

St6	*"This session was easy and I enjoyed it. The fun part is watching how other people did their websites and the creative art they website. colleagues commented on each other Padlet and gave ideas on how to improve the website. Most colleagues did it well without much challenge"*
St7	*"Task four was very entertaining, as it required us to provide constructive criticism on each other's websites, to everyone make their websites user friendly for everyone"*
St8	*"This session was easy, fun and invaluable experience obtained shall improve our upcoming research and teamwork is the key to do more than an individual"*

These findings from the PRJ form revealed that awareness of this collaborative authentic activity was acknowledged, regardless of whether all participants did not recognize it as part of reflection or not. Thus, the construction of hermeneutic learning experiences through dialogue and participants' peer interaction was evident at this point. Conversely, the learning environment may have enabled the construction of

knowledge through the abstract way of thinking rather than a concrete way of thinking. Hence, the scaffolding role of the educator during the M-MLI was frequently fundamental to the learning process (Imran, 2006). And this was improved in Cycle Three.

9.5.5 Session Five: Enable pre-service teachers to reflect on the M-ML experience

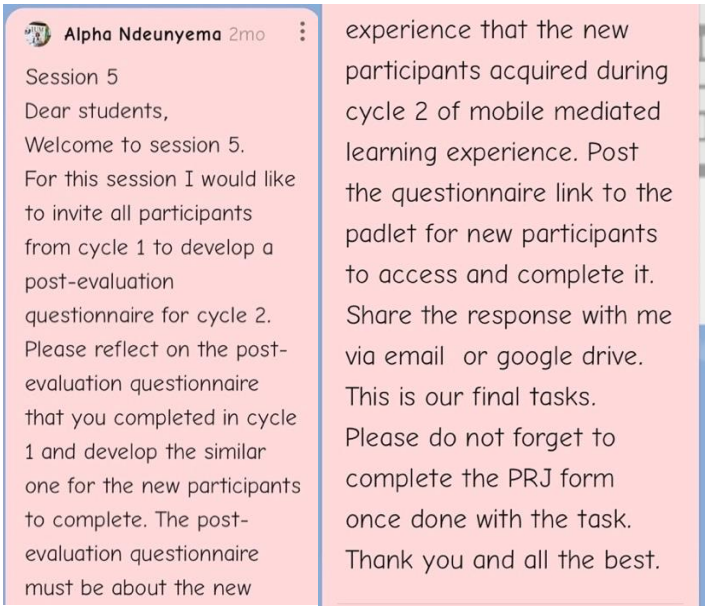
The final session of the M-MLI Cycle Two was based on the last formulated design principles of the mobile-mediated learning experiences which is reflection. To provide a learning environment that would promote reflection, Session Five was designed primarily with an authentic setting and an authentic activity to enable participants to reflect on their experiences of mobile-mediated learning of Cycle Two. The authentic activity that was design for this session was two-fold:

a) Participants from Cycle One were asked to design a post-evaluation questionnaire using Google Forms for the M-MLI Cycle Two to access and complete. This was done to give participants from Cycle One the opportunity to re-evaluate their experiences (from Cycle One) and gain new knowledge on how to design an evaluation questionnaire for an M-MLI reflection. Collaboration was also encouraged here, since all four Cycle One participants (St2, St6, St7, and St8) were required to collaborate to create a post-evaluation questionnaire for Cycle Two of M-MLI.
b) New participants (NSt1 and NSt2) were required to reflect on their first experiences of mobile-mediated authentic learning (Cycle Two) by completing the post-evaluation questionnaires.

Session Five task was posted to the Padlet wall (see Figure 9.8) by the researcher. Participants from Session One developed two different post-evaluation questionnaires and shared the google form links to the Padlet. They have indicated that they worked in pairs, meaning one post-evaluation questionnaires was developed by ST8 and ST2 (see Figure 9.9) while another post-evaluation questionnaire was developed by ST7 and ST6 (see Figure 9.10) below. The principal design aspect to instantiate authentic learning task for Session Five was to enable participants from Cycle One to reflect (in-action) and re-evaluate on their experiences and knowledge gained during Cycle One of M-MLI. While the new participants were expected to reflect (on-action) on their mobile mediated learning experiences for Cycle Two.

Figure 9.8

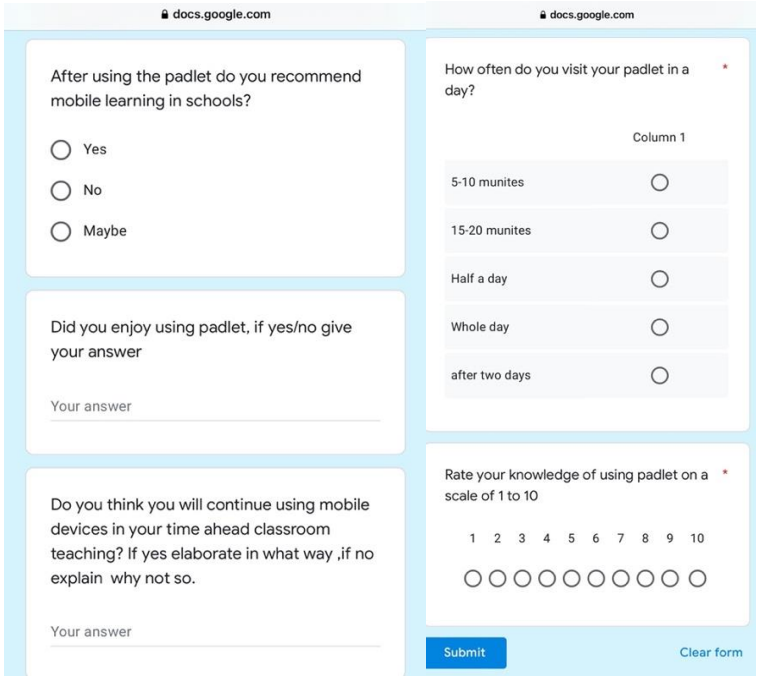
A snapshot from the Padlet for Session Five of M-MLI Cycle Two M-MLI Cycle Two



Figures 9.9 and 9.10 clearly show that participants created post-evaluation questionnaires in the same way as I did for Cycle One (see Appendix E). It was also impressive to note that that no instructions or guidance were given on how to utilize a google form to create a questionnaire, meaning, they were able to leverage their previous experience from Cycle One to do this task (see Chapter Eight, Section 8.4.4).

Figure 9.9

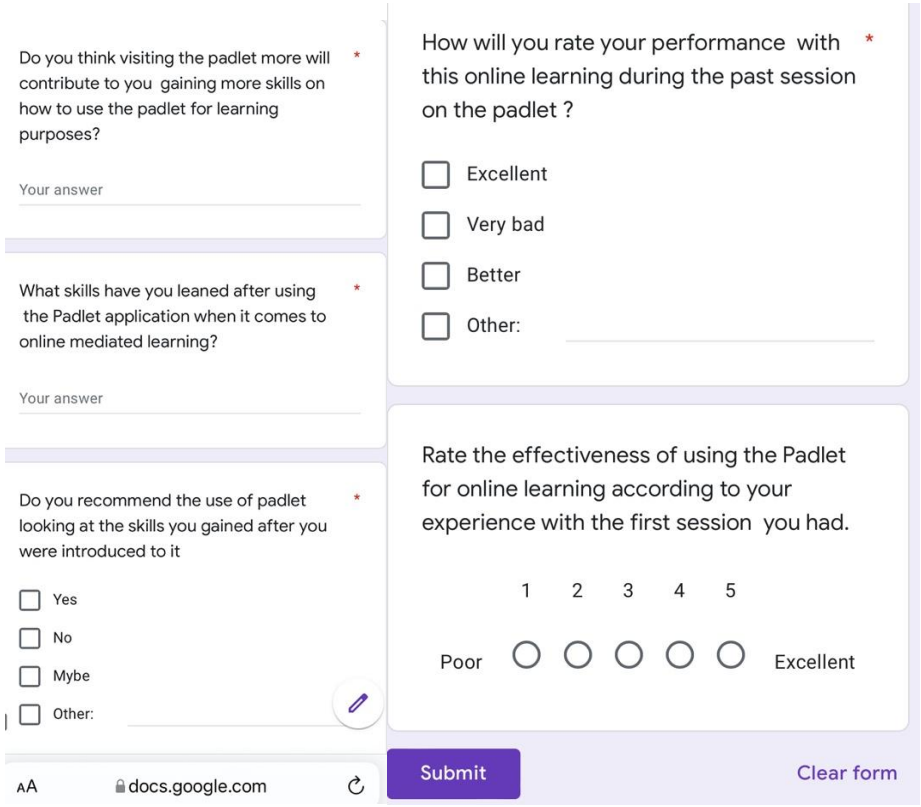
Extracted participants' artefacts from Session Five on a Padlet for M-MLI Cycle-2



Note: Developed by ST8 and ST2

Figure 9.10

Extracted participants' artefacts from Session Five on a Padlet for M-MLI Cycle Two



Note: Developed by ST7 and ST6

Furthermore, it appeared that participants effectively employed reflection for learning through experience as evidenced by the types of questions they asked on their post-evaluation questionnaires such as (see Figures 9.9 and 9.10):

> *" How will you rate your performance with this online learning during the past session on the Padlet?" "Rate the effectiveness of using the Padlet for online learning according to your experinecs with the first session you had". "Rate you knowledge of using Padlet on a scale of 1 to 10". "How often do you visit your Padlet in a day?" "What skills have you learned after using the Padlet application when it comes to online meadited learning?" "Do you think you will continue using mobile devices in your time ahead [future] classroom teaching? If yes elaborate in what way, if no explain why not so."*

Given the aforementioned qualitative sentiments, I believe that reflective skill development is an iterative process that may be reviewed at any moment before, during, or after the experience to help learners increase their level and complexity of reflection, as stated by Coulson and Harvey (2013). These sentiments also demonstrate the importance of applying past learning (M-MLI Cycle One) to the present (M-MLI Cycle Two) to address a certain issue. However, it appeared to me that the process of developing reflective tasks among the participants needed to be scaffolded for them to

learn how to critically reflect. I also observed that they did not include the questions of demographic background of responded, hence it was challenging for me to identify which responded said what between NSt1 or NSt2 during data analysis. It was therefore deemed necessary to re-address this element in Cycle Three.

A finding from the new participants' (NSt1 and NSt2) responses on the two post-evaluation questionnaires was also a good indication of reflection on-action of the M-MLI Cycle Two. In their responses, participants recognized the usefulness of the Padlet as an effective teaching and learning tool. They rated 4 and 5 (on the scale of 1 to 5) points when asked about the effectiveness of using Padlet for online teaching responding to ST6 and ST7 post-evaluation questionnaire. Similarly, new participants they both agreed that they will recommend Padlet to others or schools and they are planning to use it in their future classrooms. They have also indicated that they indeed enjoyed the use of Padlet which is also evident in M-MLI Cycle One (see Chapter Eight).

Following responses to the open-ended questions on the post-evaluation questionnaires, new participants appreciated experiences and discovering of a new way of teaching and learning using Padlet and mobile devices. For example, when asked about the skills they have learnt after using the Padlet application for online mediated learning, (see Figure 9.10), NSt1 responded that she acquired some creative skills: *"Creativity, I have learned to be creative and the Padlet has boosted up my creative ideas.* While NSt2 emphasis more on the usefulness of mobile devices in teaching and learning, as she stated: *[I learn] how to use my phone on relevant things e.g., school work*

Contrary to the participants' reflection at the end of each session by completing a PRJ, Session Five was developed to provide an opportunity for participants to reflect and synthesized their learning for the whole M-MLI Cycle Two. It also allowed the researcher to further understand how the participants view their experiences of Cycle One and Cycle Two as well as the pedagogical skills they have acquired during the interventions. The findings above clearly indicate that participants from Cycle One (St2, St6, St7, and St8) reflected *in-action* through the development and completion of an authentic task (post-evaluation questionnaires) while new participants (NSt1 and NSt2) reflected *on-action* by completing reflective questionnaires that were developed by

participants from Cycle One. Subsequently, it also addresses the research question 2 (RQ2) of this study. To that end, Coulson and Harvey (2013) argue that guiding students in identifying their values, beliefs, and assumptions about the experience can help them develop metacognitive awareness and ultimately to deeper levels of reflection and learning.

Unfortunately, no one left any comments on the PRJ form after the last session of M-MLI Cycle Two because the participants did not reflect on it. The participants were advised that they needed to fill out the PRJ form, but no responses were received. Perhaps it was because it was the Christmas season, and students were in the mood for a vacation after learning that the intervention was coming to an end. In addition, the data package I had purchased for them had expired at the time. As a result, in M-MLI Cycle Three, rather of completing a PRJ form, a final reflection was devised in the form of a discussion forum.

9.6 Iterative Cycle Two of M-MLI summary of findings

Participants' feedback on the authentic learning tasks developed for the M-MLI Cycle Two, such as Pre-and Post-evaluation questionnaires, PRJ, Observations, transcripts from the Padlet wall, and participants' artefacts on the Padlet, were carefully analysed to review the design principles that had been developed for M-MLI Cycle Two from Cycle One. Table 9.3 below is a summary of the revised design principles based on the M-MLI Cycle Two findings and how the emerged themes informed the revised design principles that were implemented in M-MLI Cycle Three (see Chapter Ten).

Table 9.3

Iterative Cycle Two of the M-MLI summary of the findings

Formulated Design Principles *(From M-MLI, Cycle One)*	**Implementation of the M-MLI Cycle Two** *(Emerged themes)*	**Revised Design Principles** *(From M-MLI, Cycle Two)*
Create an authentic mobile-mediated learning context were pre-service teachers have **access** with **a mobile device**	Despite findings showing that excellent internet connectivity and mobile network coverage are required for mobile-mediated learning to be successful, it was also critical to consider the time and place (geographical location) where pre-service teachers were at	Construct an authentic mobile-mediated learning context in which pre-service teachers have **access** with a **mobile device**

	the time of intervention, as this could allow them to be more flexible with their learning schedules. This may have prevented the two participants from withdrawing from the study and delayed responses from those who participated.	
Provide time for pre-service teachers to **explore** the features and affordance of the mobile technologies to mediate authentic learning	Propelling pre-service teachers into exploring the features and affordances of the technological tool was effective. However, its success could be enhanced if an educator (researcher) scaffolds the process so that its benefits can be fully explored.	**Scaffold** the process of exploring the **features** and **affordance** of the selected technological tool
Engage pre-service teachers in **multiple** mobile-mediated learning **activities** to construct knowledge	Engaging pre-service teachers in a variety of mobile-mediated authentic learning experiences for them to consume and produce knowledge was effective. However, it was necessary to develop an authentic task that may encourage metacognition rather than capitulation by providing detailed step-by-step instructions in the early stages of completing the task.	Engage pre-service teachers in **multiple** mobile-mediated learning activities that promote **metacognitive learning**
Provide an opportunity for pre-service teachers to use mobile-mediated learning **collaboratively**	Although participants acknowledged the collaborative task, the authentic activity that was given appeared to focus more on concrete rather than abstract thinking, which may have hampered the collaboration's efficacy.	Promote **abstract thinking** and collaboration among the pre-service teachers during the mobile-mediated learning experiences
Enable pre-service teachers to **reflect** on the mobile-mediated learning experience	Reflection in action and on-action, both as an individual and as a group, was effective through the development of post-evaluation questionnaires and peer feedback. However, reflection can also be done through a forum discussion to encourage greater participation and reflection.	Enable pre-service teachers to **reflect in-action** and **on-action** on the mobile-mediated learning experiences

9.7 Chapter Summary

This chapter presented findings from the M-MLI Cycle Two indicating the testing of the design guidelines developed in chapter seven which the intervention was operating. From the findings of the M-MLI Cycle One and Two, the revised design principles elicited from Cycle Two that has a potential to influence practice of mobile learning among pre-service teacher were developed. The next chapter ten will present the analysis and refinement of the revised design principles derived from Cycle Two of M-MLI to guide the design, implementation, evaluation and development of the mobile-mediated authentic learning solution in practice.

CHAPTER 10: IMPLEMENTATION OF THE ITERATIVE CYCLES OF MOBILE-MEDIATED LEARNING INTERVENTION (CYCLE THREE) *(DBR PHASE THREE)*

10.1 Chapter Overview

This chapter draws on the findings of the third iteration of the M-MLI cycle, which follows the implementation of the revised design principles generated from the second iterative cycle of M-MLI given in chapter nine. This is the third and final cycle of M-MLI intended to clarify on what had been observed both in the first and second cycles of M-MLI, so as they serve as evidence to refinement of the design principles. The chapter is structured in accordance with the DBR approach as alluded to in the preceding chapters.

10.2 Modification of formulated design principles and procedural tasks for M-MLI Cycle Three

Table 10.1 depicts the modification and transition of the formulated design principles to the revised design principles of M-MLI for pre-service teachers. The formulated design principles for authentic learning that were implemented in Cycle Two of M-MLI provided further opportunities to revise the design principles, following the prerequisite of the DBR approach of testing and refinement of design solutions. Following the DBR steps, it is, however, that the formulated design principles tested in Cycle Two have been altered and strengthened. By doing so, findings, recommendations, and emerged themes from M-MLI Cycle Two (see Chapter Nine, Section 9.6, and Table 9.3) were used to improve the design solution that served as the underpinning for the implementation of M-MLI iterative Cycle Three. This was still critical since it allowed for alterations and enhancements to the learning design, allowing the focus to remain on determining the best approach to communicate mobile learning in a pedagogical setting.

Subsequently, non-linear navigation authentic learning tasks were improved from Cycle Two to iterative Cycle Three after the real-life learning environment was built up to enable pre-service teachers to reflect and mediate learning through emerging mobile devices. This was necessary to enable reflection and evaluation of mobile learning experiences in accordance with the new design principles of authentic learning that guided M-MLI Cycle Three implementations. In addition, to effectively implement Cycle Three of M-MLI following the DBR approach, the personal learning environment (PLE)

was set in the same context as the previous iterative Cycle Two (see Chapter Nine, Table 9.1), but the process of authentic learning activities was modified to respond to the revised design principles of M-MLI as shown in table 10.1 below.

Table 10.1

Mobile-Mediated Learning Intervention Cycle Three Authentic Tasks

Revised Design Principles (DPs) ***(From M-MLI, Cycle Two)***	**Process of Authentic Learning Activities for Cycle Three**
Construct an authentic mobile-mediated learning context in which pre-service teachers have **access with a mobile device**	***The Researcher:*** - Ensure participants have access to WIFI/data for internet access with a mobile device - Invite at least one participant from Cycle One and Two for continuity - Create a WhatsApp Group and add participants - Allocate Pseudonyms codes for new participants. - Invite new participants to install a Padlet app on their mobile devices from the Google Play Store or Apple Store - Invite participants to sign a consent form and complete a pre-evaluation questionnaire shared on a Padlet - Introduce and explain the process, methods, timeframe, and technological tool/s of the mobile-mediated learning experience (Cycle Three) during the virtual workshop (using Zoom). ***The Participants:*** - Introduces themselves - Install Padlet on their mobile devices from the Google Play Store or Apple store before the first session on M-MLI. - Sign a consent form and complete a pre-evaluation questionnaire on a Padlet - Familiarize themselves with the learning environment (Padlet) during the workshop.
Scaffold the process of exploring the **features and affordance** of the selected technological tool	***The Researcher:*** - Invite participants to explore the features and affordances of Padlet. - Invite participants to use a Padlet to create a video and demonstrate any two Padlet features. (e.g., how to embed pictures and videos, how to create links, how to create voice recorders, how to change colours, how to create your own Padlet, how to post YouTube videos, how to use Spotify, how to attach documents and files, etc.) each participant will be allocated a different feature to present - Develop a PRJ using Google Doc and sharing a link on the Padlet - Establish action learning sets and models through the use of Padlet features.

	The Participants: - Explore the features and benefits of educational technological tool(s) (Padlet). - Develop a tutorial video on how to use any two features (that are allocated to them) of Padlet and post it on the wall. - Review each other's videos and comment - Complete the PRJ on a Padlet for sessions 1 and 2
Engage pre-service teachers in **multiple** mobile-mediated learning **activities** that promote **metacognitive learning**	***The Researcher:*** - Post a sample Google site link called M-MLI Cycle Three (a revised website that was developed for M-MLI Cycle Two). - Invite participants to develop their own websites for their subject specialization and upload the teaching materials to their websites (instructions on how to populate their website are given) - Demonstrate and scaffold the task. ***The Participants:*** - Create websites for their specialized subjects using Google Sites. - Populate and customize their website by adding content from their school's specialized subject - Post their website links on the Padlet wall for others to access them. - Blend Padlet features with other mobile apps for knowledge construction - Complete the PRJ on a Padlet for Session Three.
Promote **abstract thinking and collaboration** among the pre-service teachers during the mobile-mediated learning experiences	***The Researcher:*** - Allow for collaboration through peer assessment and with the researcher. - Use a think-pair-share activity. - Invite all students to comment on each other's task websites on a Padlet (e.g., how to improve it, whether it was nicely designed, whether the material posted was relevant to the topic chosen, etc.) that were posted on the Padlet wall from the previous session. ***The Participants:*** - Comment on each other's websites and share more ideas on how to populate their websites via Padlet. - Reflect on collaborative knowledge construction - Complete the PRJ on a Padlet for Session Four.
Enable pre-service teachers to **reflect in-action and on-action** on the mobile-mediated learning experiences	***The Researcher*** - Invites participants for a discussion forum using a Padlet Voice recorder to evaluate the M-MLI Cycle Three - Invite participants (new participants) to complete the PRJ to reflect on mobile mediated learning experiences Cycle Three. ***The Participants:*** - Participate in a Forum discussion via Padlet, share their experiences, and skills acquired, as well as re-evaluate their perception of mobile-mediated learning. - Complete PRJ to reflect on M-MLI Cycle Three after the session.

10.3 Participants of Mobile-Mediated Learning Intervention (M-MLI) (Cycle Three)

As a requirement of DBR states that each iterative design cycle should involve a selection of participants, data collection, and data analysis procedures, Cycle Three of M-MLI was setup in a similar context as cycles One and Two (see Chapter Nine). The selection of participants for this cycle was done by inviting students from my teaching methods class to submit their names to me via WhatsApp, those who were willing and able (with a mobile device) to participate in this cycle. The announcement was made during the lecture. As a result, six (6) students showed interest and agreed to participate in this cycle. The total of participants in Cycle Three was seven (7), which included six (6) new voluntarily participants and one (1) selected participant (St8) from cycles One and Two and currently a final year student) who showed more interest, was active, was motivated, and had been consistent with engaging as well as assisting others in the previous M-MLI cycles. All the six new participants were third-year female students from the commerce field of studies, as Cycle Three was aimed at refining the design principles and focusing on one field of study with different major subjects was deemed useful. The fact that only females participated in this cycle was because the third-year commerce group had few students, and the majority were females, and they were the only ones who volunteered and showed interest in participating in this intervention. It is worth noting that the earmarking of the new participant in this cycle is a continuation of the new participant in Cycle Two. Accordingly, the new participants are numbered from NSt4 to NSt9 (see Table 10.2), following the new participants in Cycle Two, which were numbered from Nst1 to Nst3.

Table 10.2

A summary of participants' background information for M-MLI Cycle Three

Student Code	Gender	Field of specialization and Year of study	Mobile device owned	Experience with Padlet before Yes/No	List of Application/website used before
ST8	M	Commerce (Fourth year) (Participant from Cycle One and Two)	Smartphone	Yes	Chrome, YouTube, Personal blog, News websites. Online portfolio. Educational websites, Padlet
NST4	M	Commerce (Third Year) (New participants)	Cellphone and Laptop	No	Google scholar, Word, Excel and PowerPoint

NST5	F	Commerce (Third Year) (New participants)	Cellphone and Laptop	No	Google, YouTube
NST6	F	Commerce (Third Year) (New participants)	Cellphone and Laptop	No	Google, YouTube
NST7	F	Commerce (Third Year) (New participants)	Cellphone	No	YouTube, Google and Google Chrome
NST8	F	Commerce (Third Year) (New participants)	Cellphone	No	Google scholar
NST9	F	Commerce (Third Year) (New participants)	Cellphone	No	Wikipedia and studocu

Findings from the pre-evaluation questionnaires for Cycle Three indicated that all new participants owned a mobile device and were experienced users of WhatsApp, YouTube, Google Search, and Google Scholar. However, they both stated that they had never used Padlet before, as presented in table 10.2.

10.4 Procedures for setting up an authentic e-learning context for M-MLI Cycle Three

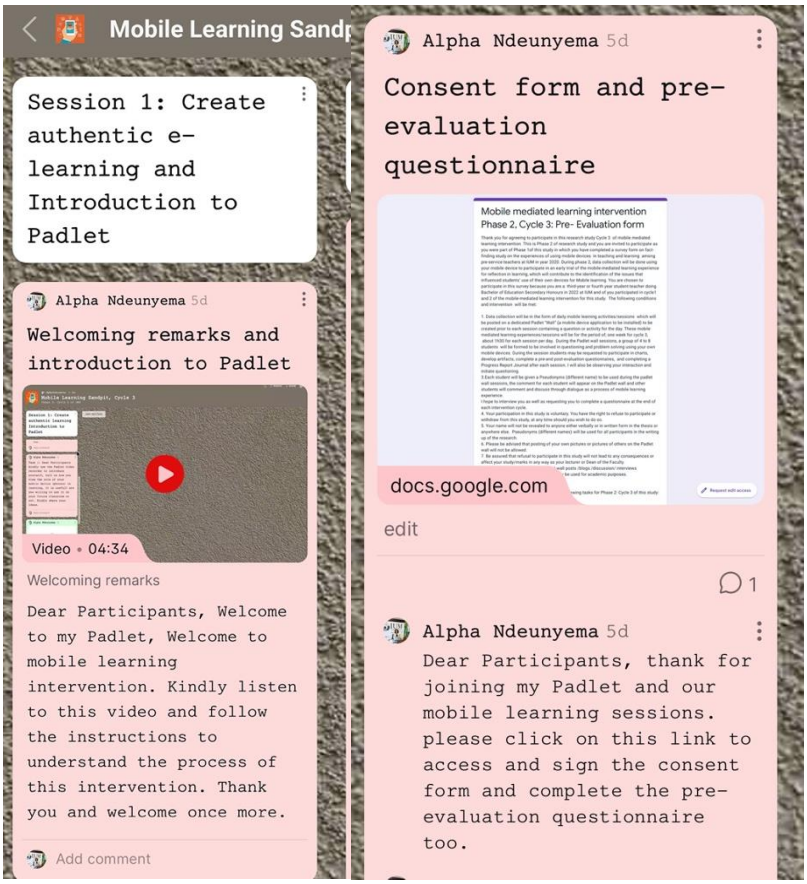
Following the selection of participants, the authentic e-learning context for Cycle Three was immediately created, while participants were still in an enthusiastic mindset to participate. The procedure of creating the authentic e-learning context began by created a Padlet wall for M-MLI Cycle Three well in advance. On the wall, I initially uploaded a pre-evaluation questionnaire, the PRJ, and the tutorial/welcoming video explaining the methods, processes, and aims of the M-MLI Cycle Three to participants. On the video, I also demonstrated to participants how to familiarized themselves with Padlet. For instance, how to create posts, how to alter colours, and which functions to employ to do Task 1 for M-MLI cycle that I also posted to the wall. I opted to use Padlet to induct participants and setting up the authentic e-learning context for the M-MLI Cycle Three, contrasting to how I created the authentic e-learning context for Cycle One (via a face-to-face orientation workshop) and Cycle Two (via orientation webinar using Zoom). Additionally, I created Padlet wall using various formatting techniques for each cycle. For instance, I used the Grid layout for Cycle One, the Wall layout for Cycle Two, and

the Shelf style for Cycle Three. The font styles used and wallpapers were also different. This was done to observe and test various functionalities and affordances of Padlet.

It was essential to conduct all the sessions—including the orientation session—via Padlet, as a chosen technological tool for this research study. However, one of the challenges that was discovered is that the Padlet's screen recorder functionality is only supported when using a PC or laptop as opposed to mobile phones. Therefore, it was not possible to use Padlet feature to screencast the orientation tutorial, alternatively, Zoom Screen Recorder functionality was used, and video was posted to Padlet (see Figure 10.1 below). After completing the designed authentic e-learning setting for M-MLI Cycle Two on Padlet, I shared the link to the WhatsApp group and invited participants to install Padlet on their mobile phones or simply follow the link to join Cycle Three Padlet wall.

Figure 10.1

A snapshot from Padlet for setting up an authentic context for M-MLI Cycle Three

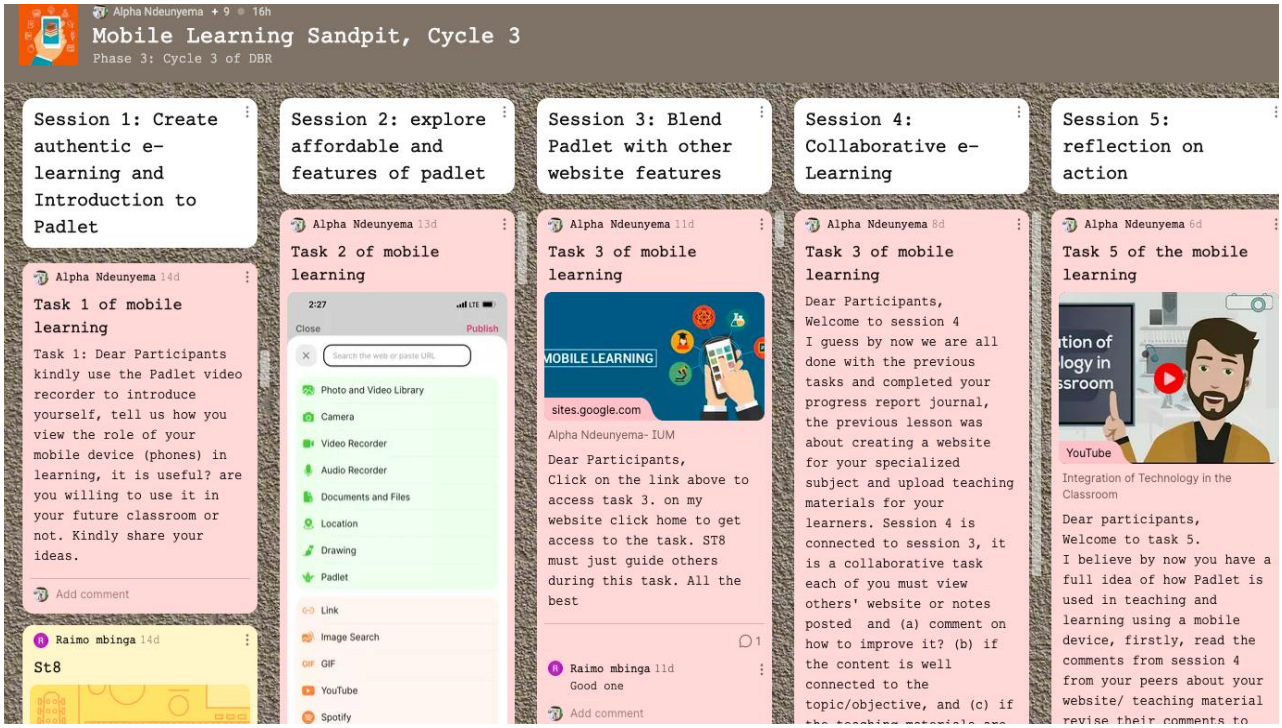


Cycle Three of M-MLI sessions began on June 23, 2022 and ended on July 8, 2022. Correspondingly, sessions 1 to 5 of the M-MLI Cycle Three (see Figure 10.2) were

based on the authentic activities for mobile learning as outlined in table 10.2. Each participant used a mobile device and Padlet to complete each task using a mobile device or phone anywhere at any time. Participants showed enthusiasm and commitment to the project. They were all active except NST5, who indicated that she was sick and was admitted to hospital and could not participate up to the end of the project. Irrespective of the said challenges, all remaining participants were willing, contributed and participated well from the beginning to the end of the project. My role as a researcher in collaboration with ST8 who participated in the previous iterations 1 and 2 of the M-MLI was to coordinate, scaffold, support, and model the learning and the use of technology features of a chosen platform (Padlet) that could be accessed via participants' mobile devices.

Figure 10.2

A snapshot from the Padlet for Session One to 5 of M-MLI Cycle Three



The following section represents how the data was collected and analysed for Cycle Three of the M-MLI.

10.5 Data Collection and Analysis of M-MLI Cycle Three

Following the data collection procedures/instruments and analysis of findings from M-MLI cycles One and Two, data from Cycle Three was obtained in a consistent situation. A pre-evaluation questionnaire was administered, as well as data from chats and

transcripts from the Padlet wall, participant artifacts (including website designs, teaching notes, and audio voice recorders), peer comments, observation of participant participation, forum discussion, and the PRJ were also collected. Subsequently, data was collected from five sessions, with each session aimed at testing and implementing the revised design principles mentioned in the preceding sections. Each session was posted on the Padlet wall, and participants were given at least two to three days to complete a task.

As described in chapters eight and nine, WhatsApp (a popular mobile instant messaging service among IUM students) was still used to post notifications, updates, and comments, as well as to check for new posts or changes to a Padlet. it must be noted that all M-MLI Cycle Three authentic tasks were completed on Padlet, with WhatsApp wholly used for immediate notifications and announcements. To this end, hermeneutic cycle-driven analysis and evaluation of M-MLI Cycle Three findings were again done according to the revised design principles of mobile-mediated authentic learning (see Chapter Five). The proceeding session presents the analysis for each session of the authentic M-MLI, Cycle Three.

10.5.1 Session1: Construct an authentic mobile-mediated learning context in which pre-service teachers have access with a mobile device

Session One was aimed at creating an authentic mobile-mediated learning context for Cycle Three of the M-MLI. The participants were enthusiastic and excited to learn about Padlet after the e-learning environment was created and the Padlet link was shared with them on WhatsApp (see Figure 10.3 above). An exemplar artefact of the use of Padlet voice recorder and video recorder were also posted on the wall in advance (see Figure 10.2), also a pre-recorded tutorial video of the use of Padlet and its features was also developed and shared. Moreover, a consent form and pre-evaluation questionnaire was also posted to the wall. I also introduced the new participants to participant ST8 from cycles One and Two, explaining that he would be the one to instruct or assist them and mimic the use of the tools that we were using during the intervention.

Responses from the pre-evaluation questionnaire (questions 1,6 and 7) indicated that all participants found mobile devices useful (rating 5 points) in their studies. When asked the extent to which they rate their knowledge of using mobile devices in teaching

and learning four (4) out of six (6) new participants rated that they are highly knowledgeable, (rating at 5) while two (2) indicated that they are somehow knowledgeable (rating at 3). And when asked if they would let their future learners to use their cell phones in class, they all responded yes. Their reasoning further shows that they were not yet exposed to the innovative pedagogies and technological enhancement of what mobile phones could offer for teaching and learning. Rather, they viewed mobile phones as a tool searching and sharing for academic information rather than as a teaching and learning tool (this agreed to the findings from the fact-finding study, see Chapter Five):

> ***NSt4:*** *"yes, the reason behind is that for them to provide relevant answers and and information to the questions I will be asking them. To be able to know how to tackle questions by searching information on internet as the they are progressing ahead. For my learners to understand how their mobile phones are very useful for their educational purposes."*
>
> ***NSt7****: "yes, I would, for every discussion topic I would like them to have access to information, and give answers quickly as they now have access to educational apps and various audios explaining different information".*
>
> ***NSt8****: "yes. Using them to listen to YouTube videos and complete online quizzes that I will provide."*
>
> ***NSt9:*** *"yes, I will only allow my learners to use their mobile phones when ~~they~~ [there] is a need especially during class debates and discussions and where we enquire difficult words."*

The first authentic activity was aimed for participants to introduce themselves and share their thoughts or ideas regarding mobile learning or the using mobile devices in teaching and learning using a Padlet voice recorder. Each participant was required to post a voice recorder for no longer than seven (7) minutes. Each voice recorder was transcribed and analysed individually. The reason behind this task was meant to assist me to understand participants' preconception and pre-judgement about mobile learning and the benefits of mobile devices in teaching and learning.

Participants' feedback from their voice or video recorder that they posted to the wall indicated that they recognized the benefit of mobile devices in teaching and learning, contrasting them to a more didactic way of obtaining and searching for information. This echoed my previous views that pre-service teachers at IUM exclusively see mobile devices as a tool for academic information searching and sharing. For example, some participants stated:

My mobile phone enables me to search information or watch a YouTube video when I do not understand a topic from class (NSt8, NSt4, NSt6).

Is easy for me to access lecturer notes or assignment that is shared on our WhatsApp group (NSt7, NSt9).

All participants commented on the usefulness of mobile devices in teaching and learning, illustrating its mobility, ease of use, available of multiple apps and communication among students-peers or students-lecturer. The mobility of the device and connectivity enabled the participants to create content in real world contexts. It subsequently, gave participants the opportunity constructs their own understanding and acquire new knowledge of using mobile devices as a teaching tool:

My experience using the Padlet is that I can now install a Padlet app on my phone and go to the Padlet website and create an account and make my board and share the link with my fellow students or learners so that we will be discussing our subjects or modules using the Padlet (NSt6, PRJ).

10.5.2 Session Two: Scaffold the process of exploring the features and affordance of the selected technological tool

Session Two task of authentic M-MLI Cycle Three was created to allow participants to become accustomed with Padlet affordances and functions (see Figure 10.3). The primary focus to redesign this learning task was to address the issue of inducting and scaffolding (as per my observation in M-MLI Cycles One and Two) participants' into becoming self-driven and determining their learning skills and knowledge during learning. Participants were provided with support and guidance to successfully complete this task.

By doing this, I screen casted a video that modelled the function of one of the Padlet's features and posted it to the wall. I also requested ST8 from Cycles One and Two to make a video explaining how to screen record and which app to install in the smartphone to be able to do a screen recorder. Following that, each participant was assigned two Padlet features to create a screen casting video explaining how to use them (see Figure 10.3).

As a result, findings from the scaffolding of the process of exploiting affordances of the technological learning tool (Padlet) mirrored my own observations from M-MLI Cycles One and Two. My observation was that modelling of the technological tools and their affordances played an important role for the students to understand their use in

academic contexts (Narayan et al., 2019). Findings from the PRJ cement this sentiment:

> *The fact that Ms Alpha [the researcher] gave us a task to do screen recording, I was like where will I even start. Based on the steps and guidance provided by her. I was able to complete the tasks and apply all those features mentioned for me to use. I am looking forward to the next task to challenge my capability (NSt8, PRJ).*
>
> *..I love the fact that she [the researcher] introduced the Padlet step by step, and took me through it thoroughly. I can now say with so much pride that I know how to send audio on the Padlet. I could share my views with no one judging me as the app is user-friendly. And it doesn't take up too much space. And the fun part it's that we are going by code (pseudonyms) names. how cool is that? I am honestly having so much fun. And am eager to learn more on this journey (NSt7, PRJ).*

Figure 10.3

A snapshot from the Padlet for Session Three of M-MLI Cycle Three

To this end, the availability of mobile devices and Padlet affordances incorporated in designing for participation enabled participants to create and share their authentic content to the Padlet wall.

The affordances also provided the students with the opportunity to enact authentic mobile-mediated learning in real world contexts.

> *In this session, I have learned how to use some Padlet features while explaining to others and from my colleagues' videos that have uploaded on this platform (Padlet) (NSt4, PRJ)*

On the other hand, findings also suggest that the model and make of the mobile smartphone or device owned must be able to accommodate the technological applications and must have enough storage to install new apps etc. For example, NSt4 indicated that she was struggling to install the screen recorder on her phone due to limited space or slowness of the device navigation etc. and she has to use another platform to screen cast and upload her video to Padlet. She alludes that

> *I didn't enjoy this session because at the time for me to share the video I have recorded on the platform it first needed to be uploaded on YouTube and then I had to copy the link and paste it on the Padlet so I publish it. It was kind of a long process for me.*

The aforementioned sentiment implies there are some technical challenges that are associated with mobile devices affordances, such as connectivity and battery life; screen size and key size; the number of file/asset formats supported by a specific device; multiple standards and screen sizes; multiple operating systems; and limited memory (see, Mehdipour & Zerehkafi, 2013), which may hinder the acceptance of mobile learning and may not be ignored.

10.5.3 Session Three: Engage pre-service teachers in multiple mobile-mediated learning activities that promote metacognitive learning

Session Three of M-MLI Cycle Three focused on refining the design concepts for involving participants in multiple mobile-mediated learning activities to encourage metacognitive learning and provide an opportunity to elicit more knowledge. This was important in triggering higher cognitive learning among the participants through multiple authentic mobile mediated learning activities. At this point, I uploaded task 3 on the Padlet wall along with a model website that I created and updated for M-MLI Cycle Two (see Figure 10.4). This task enabled participants to explore the learning context from numerous perspectives and blend Padlet with other website features as well as with their subject specialization.

The ability for participants to create their own website and embed them to Padlet using the mobile phones affordances provided them with creative freedom allowing them to express their excitement of the new knowledge acquired, making the learning interesting and purposeful:

> *Session Three, It was really exciting since I got a chance to create my website for the first time, I didn't have an idea how to create it before. I really enjoyed this session even at first, I was struggling to add the PowerPoint presentation slides, some pictures and videos to my web page. It really took me time to complete it but, in the end, I ended up liking the outcomes (NSt4, PRJ).*

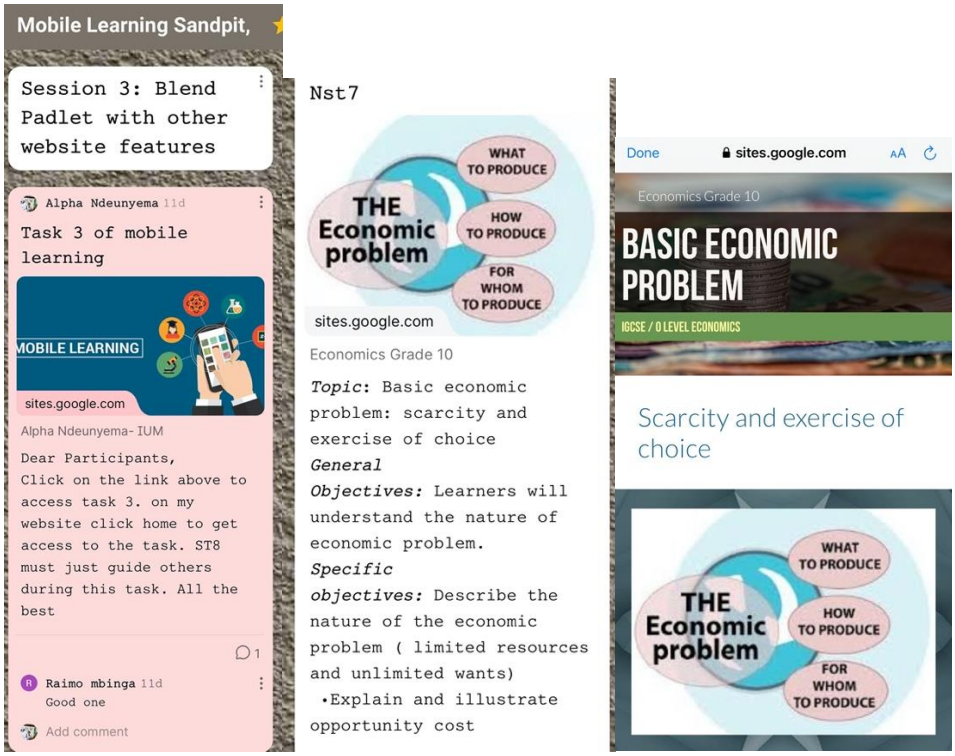
> *Gained a vast amount of knowledge on how to create a website, how to post information on it and lastly share it on Padlet (NSt5, PRJ)*

NST8 commented on the mobile smartphone affordances and its benefits too:

> *It was an amazing task. It made me realize that we got smartphones but we can use them to create certain tasks or videos. It was complicated though cause my phone can't accommodate some apps but through teamwork from my teammates, I was able to complete the tasks. Plus all the necessary information and instructions were given to enable us to complete the tasks.*

Figure 10.4

Extracted participants' artefacts from Session Three on a Padlet for M-MLI Cycle Three



Findings also suggest that providing participants with multiple mobile-mediated learning activities played an important role in helping them to build capability, as it provided them with mobility and the opportunity to apply their knowledge and skills in various new and

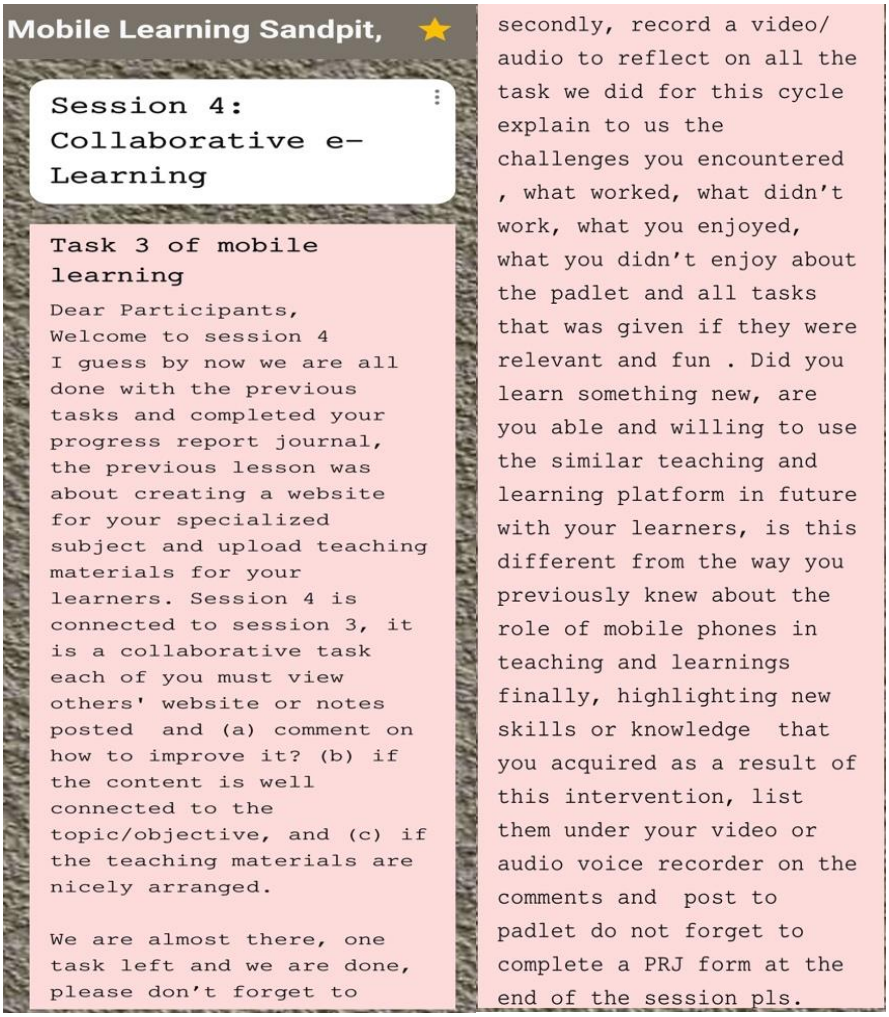
unfamiliar settings. For instance, NSt9 stated that "more and more every day I keep on learning new skills on the Padlet and it's really broadening my knowledge" (on a PRJ). This implies that the learning context that was created enabled metacognitive learning among the participants, which was the reason why this design principle was revisited.

10.5.4 Session Four: Promote abstract thinking and collaboration among the pre-service teachers during the mobile-mediated learning experiences

Session Four of the mobile-mediated learning Cycle Three aims to enable participants to participate in a collaborative mobile learning context. This design principle was, however, revised to design a collaborative context that encourages engagement with each other to stimulate the development of abstract thinking rather than concrete thinking.

Figure 10.5

A snapshot from the Padlet for Session Four of M-MLI Cycle Three



Along with the design of a collaborative authentic task (see Figure 10.5), task 4 of a M-MLI Cycle Three was designed to enabled true-collaboration between participants and instructors (St8 and the researcher), allowing the others (new participants) to seek assistance when needed while allowing the instructors to provide feedback when it is necessary. By doing this, participants were invited to view and comment on each other's websites that they developed in Session Three with a clear guideline (such as to comment on the design, content, etc.) on what to comment and how to comment too. This was aimed to address my observation from the previous Cycle Two of M-MLI that the collaborative task given was not well designed to promote participants' full engagement to develop abstract thinking and gain knowledge.

Findings from the PRJ suggest that the collaborative authentic task given enabled participants to compare the mobile learning content and learning shared by the peers allowed participants to construct their own understanding and acquire new knowledge. For example, participants encapsulated during their reflection that:

> *It was easy because I have just to go through all my colleagues' work for task three to go through their website and read notes and watch videos and comment on them by answering some asked questions. I enjoyed going through others' website and checking how well they presented their teaching materials that I ended up learning more about that. This task was more about acknowledging the good work for others and motivating them to do better in future, that is what I really enjoyed more (NSt4, PRJ).*

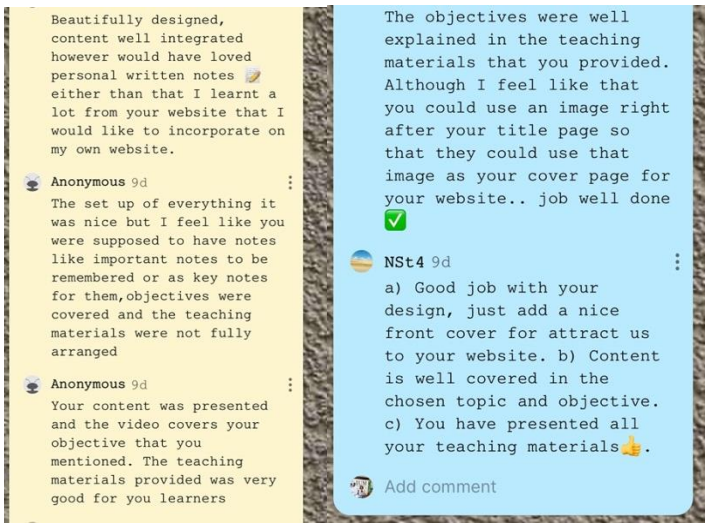
> *I had to go through my colleague's website, and I must say going through it, I learned a few things that could help me adjust my website…some of my colleagues' websites were so knowledgeable and eye-catching, that they out-did their layout as it was simply fantastic. We also had to comment on each other's work… Am honestly enjoying every part of this Padlet journey ♡□🤩 (NSt7, PRJ).*

> *It gave me an opportunity to view and see how others make their website with notes and everything It was fun to read and through the work or website of others I got to learn a lot of things from their websites also (NSt9, PRJ)*

While NSt5 commented on the advantage of collaborative learning, illustrating the constructive criticism that others commented:

> *a beautiful experience interacting with fellow participants. Gathered more skills on how to improve on my content to achieve all the objectives. Participants really gave constructive criticism. Loved everything about Task 3, especially how everyone was just so helpful and kind to each in the best possible way.*

This is an evident from some of the participants' comments on Padlet as shown on the extract below:



The intentionally designed collaborative learning context to promote abstract thinking did appear to serve the purpose of helping participants to become critically self-aware through different enablers— peer assessment, creating of course websites and helping identify strengths and weaknesses for creating innovative knowledge. This also gave them opportunities to engage in an authentic collaborative learning via mobile devices as they learn to become future teachers. To this end, I observed that participants enjoyed sharing personal experiences and skills with their peers as well as learning new things from each other's work (websites).

10.5.5 Session Five: Enable pre-service teachers to reflect in-action and on-action on the mobile-mediated learning experiences

Session Five aims to allow participants to engage and international reflect both as an individual and as a group for deeper reflection (both in-action and on-action) on their M-MLI experiences for Cycle Three. To enable deeper reflection for this intervention as pre the revised design principle, the authentic task of this session (see Figure 10.6) was designed to enable participants to revisit authentic learning activities, pay attention to feelings, and re-evaluate their experience and skills acquired during the intervention.

Reflection on-action was enhanced through forum discussion at the end of the M-MLI cycle, which encouraged deeper reflection for the whole intervention, while reflection in-action was maintained via a PRJ, where participants recorded their experiences after each session. Figure 10.6 depicts the authentic mobile learning task that was posted to the Padlet, which invited participants to reflect on-action by recording a podcast and

posting it to the Padlet. By doing so, participants were asked to explain in their voice recordings what worked, what didn't work, what they enjoyed, what they did not enjoy, what new things they learnt, and whether they are willing to apply the same learning context in their future classroom. Did the new experience shift their disposition when it comes to mobile learning?

The Padlet voice recorder was discovered to make a more significant contribution to participants' ability to reflect on and synthesize their mobile authentic learning experiences. Each participant recorded an audio within the range of 3 minutes to 10:30 minutes (see Figure 10.7), sharing their feelings, experiences, challenges, and reflections on their learning to a deeper level of intellectual analysis.

Figure 10.6

A snapshot from the Padlet for Session Five of M-MLI Cycle Three

Osborne et al., (2013) contend that a functional perspective incorporates time into the affordance idea and enables the exploration of technologies as both tools and specific places with functions that take place within and across time. Responses from the

participants' audio recorder indicated that they acknowledge the features and affordances of Padlet, referring to its functionality, usefulness, ease of use and that they enjoy their first experience of using Padlet, paying attention to their feelings and re-evaluate their experiences. For instance, participants encapsulated during their podcast that:

> *"I want my future learners to use this App and communicate their teaching and learning there. I never knew there is an App called Padlet where to post notes, teaching material web links etc. it was super amazing to use Padlet to teach… is really amazing, I am looking forward to use it in future" (NSt8, audio recorder).*

> *"The Padlet has all the features that you can use to post or get information you want e.g., image search GIF, and web search" (NSt4, audio recorder).*

> *"With a Padlet it keeps notes even if the learners were not in class (online), they can always come back to the Padlet and find a video that the teacher recorded and catch up. No need to make copies for the notes for learners, which is cost effective (NSt9, audio recorder).*

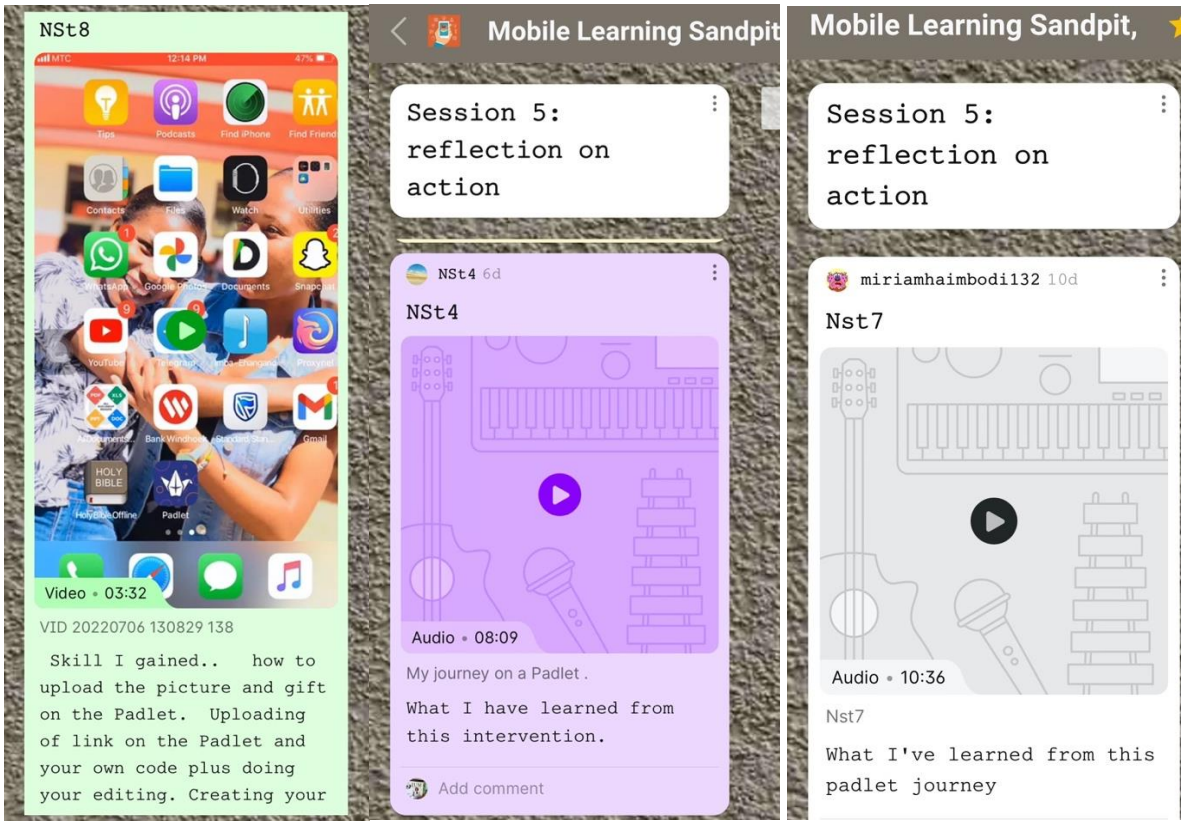


Figure 10.7: Extracted participants' artefacts from *Session Five* on a Padlet for M-MLI Cycle three (Padlet3, 2022)

The Padlet affordances also provided the participants with the ability to reflect on their mobile mediated learning experiences and practices, helping them to build new and transferable knowledge and skills. For example, NSt5 applied the skills she had learnt

from mobile-mediated learning experiences and encapsulated this idea in the metaphor of lifelong learning, and how she will use Padlet for her future learners:

> *"I will use Padlet in my future teaching as I will post all my notes or share them there, I will also create links, or pictures from websites etc. for learners who will be struggling with some activities or objectives in the subject they will be able to come to the platform and if they are shy, they can just post the voice asking questions without showing their faces or names and no one will be able to know that is them. My learners will go to the Padlet anytime they want to access the material for the subject."*

Reflection in-action for mobile-mediated learning experiences supports participants to reflect at the end (on-action) of their mobile-mediated learning experience and enables participants to synthesize and appreciate their learning. Reflection and learning may continue long after the experience and academic tasks have been completed, especially if scaffolding was effective in fostering the development of reflective ability and agency (Coulson & Harvey, 2013). This was evidence when participants the acceptance of mobile learning in their future classroom. For instance, NSt7 commented on the benefits of mobile learning and how it may transform the education system in Namibia:

> *"To be honest I did not know we can use our mobile phones to do all things and I didn't even know that there is this the App that you can use for education purposes that is very knowledgeable and you can upload anything like teaching materials, links, website, it was enlightening. The advantage is that every learner and every student have a mobile phone and is affordable so parent can afford to buy for their children and have this Padlet on. Compare to a Laptop which is expensive. We must include this in our curriculum in school our education system with drastically change to be to greater things, this was a great experience ever" (audio recorder).*

Findings from the voice recorders also suggest that the roles of ST8 and the educator (researcher) played an important role in supporting and scaffolding the new participants. According to them, ST8 (fellow student) played a dynamic and versatile role as he was always available, giving them good guidance and support, which helped them to complete most of the authentic mobile learning tasks that were challenging. For example, some participants alluded to the true-collaboration and scaffolding during their mobile mediated learning experiences that:

- *"ST8 was helping as he was guiding us where we were struggling, he was always active and helped us a lot" (NSt9, voice recorder).*
- *"Creating the website challenges my creativities which was fun and interesting, I following Ms Alpha (researcher) Instructions and a video that she posted on her website on how to develop a website and I am proud of myself that I managed to*

create my own website and post teaching material for my subject" (NSt7, voice recorder).

- *"I enjoyed the comments that were posted by my colleagues that they enjoyed my work and I did well in my task and all that it really motivates me and encouraged me to do far better and put more efforts" (NSt8, voice recorder).*
- *"I learned a lot from my colleagues when they commented on how to improve my website which I did" (NSt5).*

Othering reflected on the mobile devices technical challenges referring to the memory, space, operating system, model etc that may hinder with the successful delivery of mobile-mediated learning. This was evident in the following statement:

> *During the intervention I have encountered challenges that I have to remove my favourite Apps from my phone just to accommodate the apps that were needed for the intervention for example a Padlet, Google drive and Screen Recorder app (NSt8, voice recorder).*

Participants' responses on the authentic mobile mediated learning tasks developed for the M-MLI Cycle Three, such as pre-evaluation questionnaires, PRJ, Observations, transcripts from the Padlet wall, and participants' artefacts on the Padlet, were carefully analysed to review the design principles that had been developed for M-MLI Cycle Three from Cycle One and Two. Below (Table 10.3) is a summary of the refined design principles based on the M-MLI Cycle Three findings and how the emerged themes informed the refined design principles that are recommended for mobile-mediated learning practices (see Chapter Eleven).

Table 10.3

Iterative Cycle Three of mediated-mobile learning intervention summary of the findings

Revised Design Principles ***(From M-MLI, Cycle Two)***	**Implementation of the M-MLI Cycle Three** ***(Emerged themes)***	**Refined Design Principles** ***(From M-MLI, Cycle Three)***
Construct an authentic mobile-mediated learning context in which pre-service teachers have access with a mobile device	The mobility of the device and connectivity enabled the participants to create content in real world contexts. It enabled construction of knowledge through mobile learning environment	Construct an authentic mobile-mediated learning context in which students have access with a mobile device
Scaffold the process of exploring the features and affordance of the selected technological tool	An on-going scaffolding and modelling of the use of the technological tool and its affordances encourages participation, productivity and construct of knowledge by the	Scaffold and model the process of exploring the features and affordance of the selected technological tools

	participants. Mobile devices technical challenges such as limited memory, screen size, operating system, make and model were identifying	Facilitate mobile learning using tools that are open, accessible and compatible students' owned devices
Engage pre-service teachers in multiple mobile-mediated learning activities that promote metacognitive learning	Providing participants with multiple mobile-mediated learning activities played an important role in helping them to build capability, as it provided them with mobility and the opportunity to apply their knowledge and skills in various new and unfamiliar settings.	Design and scaffold multiple mobile-mediated learning activities that promote metacognitive learning
Promote abstract thinking and collaboration among the pre-service teachers during the mobile-mediated learning experiences	Participants could seek scaffolds for learning through collaboration with peers and educator via Padlet through connectivity, interactions across, peer assessment, sharing ideas, inquiry and problem solving.	Design and scaffold collaborative mobile-mediated learning context that encourages students' participation and peer assessment to promote abstract thinking
Enable pre-service teachers to reflect in-action and on-action on the mobile-mediated learning experiences	Reflection in-action during the process of intervention for each session by recording on a PRJ enabled participants to make sense and develop meaning from their mobile learning experience While reflection on-action through forum discussion (voice recorder) at the end of the M-MLI Cycle Three encouraged participants to reflect on the lifelong learning and professional practice	Design and scaffold on mobile-mediated reflective learning that encourage students to reflect in-action and on-action

10.6 Chapter Summary

This chapter presented findings from the M-MLI Cycle Three indicating the re-testing of the revised design principles from Cycle One and Two in which the intervention was operating. From the findings of the M-MLI Cycle Three, the refined design principles elicited from Cycle One, Two, and Three that has a potential to influence practice of mobile learning among pre-service teacher have emerged. The next chapter eleven is the analysis and refinement of the design principles derived from the study to guide the design, implementation, evaluation and analysis of mobile-mediated authentic learning context. It also introduces Phase Four of DBR.

CHAPTER 11: REFLECTION TO PRODUCE REFINED DESIGN PRINCIPLES FOR MOBILE-MEDIATED ACTION LEARNING
(DBR PHASE FOUR)

11.1 Chapter Overview

This chapter represents Phase Four of DBR illuminating the process of formulating, implementing, evaluation and refinement of the design principles related to mobile-mediated action learning in which the intervention for this study operated. Firstly, reflection on the procedural of all four DBR phases illuminating activities done for each phase is highlighted. Secondly, a summary of initial design guidelines, formulated design principles, revised design principles, and refined design principles are presented and then the refined design guideline to be reflected in practice is presented based on the literature and the findings of the study. The chapter concludes by explaining the limitation of this study.

11.2 Reflection on the Design-Based Research (DBR) phases for this study

This study is set within the overall framework of design-based research (DBR), which was chosen as an appropriate and justifiable approach for this study because of its relevance and specific incorporation of educational technology and its affordances (see Chapter Two, research methodology). A key element of DBR is the close collaboration between the researcher and practitioner to identify problems and devise design solutions. This provides a realistic framework for the study and ensures that it has a direct impact on practice, which helps improve or elicit transferable knowledge (design principles) and contributes to theory (Narayan et al., 2019). Correspondingly, the study was conducted using the DBR four phases following a systematic DBR process that led to the refined design principles for practice in a mobile learning context. Each phase has been implemented as follows:

11.2.1 Phase One: Analysis of the research problem with practitioner in education field

The first phase of the DBR method was devoted to identifying and researching the study's problem and its educational context's significant practical challenge. During this phase, an initial fact-finding study (see Chapters Three, Four, and Five) was conducted with practitioners from the International University of Management (lecturers, IT practitioners, and pre-service instructors). A fact-finding study was carried out in order to work with practitioners and pre-service teachers to clarify the practical issues that were emerging surrounding mobile learning. It also sought to investigate and

comprehend how practitioners and pre-service teachers perceived the usage of mobile devices in teaching and learning (responding to research question 1, RQ1). By doing this, an online questionnaire web link was sent to all third-year students pursuing a Bachelor of Education in secondary honours (with 114 respondents) and an interview with six (6) practitioners was conducted via Zoom web conferencing. A fact-finding study was supplemented by a review of related literatures (see Chapter Four) in order to further explore and identify educational problems connected to mobile learning and that lead to the formulation of research questions and objectives of the study.

Ultimately, during Phase One of DBR, the study's practical research problem was clarified, and research questions and objectives were formulated and finalized. This was done following the analysis of the fact-finding study and review of literature, which emphasized the need to train both educators and pre-service teachers on how to integrate mobile devices as a teaching tool and the importance of doing so. In order to address the complexities of the identified practical research problem on mobile technologies in teaching and learning and how they can be more effective as a pedagogical tool, I began by listing my pre-assumptions questions such as: where does one begin? How can one integrate mobile devices into teaching and learning? How can one teach with mobile devices? To respond to these questions, I found it imperative and essential to design, model, and mediate the effective use of mobile devices in teaching and learning. The study's objective was characterized as creating a mobile-mediated pedagogical learning and theoretical framework that can guide teacher training (in this case, pre-service teachers) on how to use mobile devices as a teaching and learning tool. Research questions were also formulated to address practical research problem (see Chapter one). Hence, DBR was found suitable for this study. As a result, developing a learning solution for this study was required and determined during Phase Two of DBR.

11.2.2 Phase Two: Development of solutions informed by existing design principles and technological innovations

During the analysis of the research problem in Phase One of DBR, I discovered that the concept of situated learning, learning through real life setting, learning by doing and learning by experience can be an effective pedagogical approach of delivering a mobile-mediated learning environment. Therefore, during Phase Two of DBR, I consulted again the literature to identify the existing design guidelines that deemed fit to address the

research problem and research questions of this study (see Chapter Seven) based on my findings from Phase One.

A design guidelines to address the identified practical problem for this study that guided the framing of M-MLI for pre-service teachers was informed by the existing design framework of authentic learning by Herrington and Oliver (2000) linked with theory of AL and HLE (see Chapter Six). The design solution was advanced by the Triadic Zone of Proximal Development framework (see Eun, 2019; Ng'ambi & Bozalek, 2016); the design of the Personal Learning Environment (PLE) (Korhonen et al., 2019; Martindale & Dowdy, 2016) and evaluation model by Kirkpatrick (Alsalamah & Callinan, 2021; Praslova, 2010) with the goal of developing a meaningful and relevant M-MLI.

Subsequently, development of the design guidelines were framed using five elements of authentic learning by Herrington and Oliver (2000) which were deemed fit for this study:

- Provide authentic contexts that reflect the way the knowledge will be used in real-life
- Provide Authentic Tasks
- Multiple roles and perspectives
- Support collaborative construction of knowledge
- Promote reflection to enable abstraction to be informed

Having developed the design guidelines for a mobile-mediate learning Intervention, the next phase of DBR was to test and refine the solution in practice.

11.2.3 Phase Three: Iterative cycles of testing and refinement of solutions in practice

During Phase Three of DBR, was the implementation and evaluation of the proposed design guidelines for mobile mediated learning solution developed during Phase Two of DBR. The five elements of authentic learning drew from Herrington and Oliver (2000) enabling the initial design guideline of M-MLI. Hence, the iterations have to take place in an authentic educational setting, with the participants being uninformed of the underlying research objective and observations. As a result three iterative cycles of M-MLI were designed and implemented (see Chapters Eight, Nine and Ten). The first cycle was implemented immediately after the construction of the design guidelines using the elements of authentic learning context. All cycles were planned as any research study: where selection of participants was done; procedural process of

implementing and evaluating the intervention was done; data collection procedure to answer the research questions (RQ2, RQ3 and RQ4, see Chapter One) and data analysis procedures was also done.

During the iterative cycles of testing and refinement of the mobile mediated learning in practice, I had to perform the roles of researcher, mentor, instructor, and observer. This empowered me to design, revise, and adjust the designed solution as I saw fit throughout the process. The first step I did for the implementation of M-MLI was to select the appropriate technological tool for the intervention which is Padlet. Secondary, I created an authentic personal learning environment (PLE) for each iterative cycle with different mobile-mediated authentic learning activities via a Padlet wall. Furthermore, the data collection instruments were also developed such as pre- and post-evaluation questionnaire, PRJ (reflections. Furthermore, a new Padlet wall was created for each iterative cycle where the researcher and participants work collaboratively to address the designed solution. Each cycle consisted of seven (7) to eight (8) participants (following the action learning framework) who were willing to volunteer and able to participate in each cycle.

Table 11.1

Summary of the systematic procedural process and reflection of iterative cycles of M-MLI (DBR Phase Three)

ITEM	Fact-finding study *(Chapter 5)*	M-MLI, Cycle One *(Chapter 8)*	M-MLI, Cycle Two *(Chapter 9)*	M-MLI, Cycle Three *(Chapter 10)*
Participants	114 Pre-service teachers and 6 lecturers	8 Participants	8 Participants	7 Participants
Design principles	Identifying existing design principles	Design Guidelines from Herrington and Oliver (2000)	Formulated Design Principles from Cycle One	Revised Design Principles from Cycle Two
Duration	1 Oct 2020 to 2 Dec 2020	19 May 2021to 31 May 2021	19 Oct 2021 to 18 Dec 2021	23 June 2022 to 8 July 2022

Data collection instruments	Online Questionnaires Interview	Pre-and-post evaluation questionnaires. PRJ. Posts transcripts on Padlet. Participants' artefacts. Observations	Pre-and-post evaluation questionnaires. PRJ. Posts transcripts on Padlet. Participants' artefacts. Observations	Pre evaluation questionnaires. PRJ. Posts transcripts on Padlet. Participants' artefacts. Observations. Forum discussion

A considerable volume of data was captured through the pre-and-post evaluation questionnaire, PRJ, posts transcripts on Padlet, participants' artefacts, observations, and forum discussion. On the other hand, the learning environment was implemented with three different cohorts of pre-service teachers at the International University of Management (IUM) doing their third- or fourth-year secondary education honours over the period of two years. The reason for choosing this group of pre-service teachers was that they were doing or had done a teaching methodology course, which intent to equip pre-service teachers with pedagogical skills in their subject specialization. Data collected from the three iterative cycles were analysed and results from each cycle were used to identify areas for improvement to be implemented in the following cycle. For instance, results from the first iteration (see Chapter Eight) were used to design the learning solution for the second iteration (see Chapter Nine), which later informed the design solution for the third iteration (see Chapter Ten).

11.2.4 Phase Four: Reflection to produce design principles and enhance solution implementation

The findings from each iteration in Phase Three of DBR, as well as adjustments made to the learning environment between them, allowed me to reflect on the entire process in the last phase (Phase Four) of DBR for this study. This allowed me to develop a refined set of design principles as a contribution to theory and practice of mobile learning. Table 11.2 presents how design principles were developed, unfolded, and revised from each iterative cycle of M-MLI, informing the final refinement of the design principles.

Table 11.2

Presents how design principles were developed, unfolded and revised from each iterative cycle of mobile-mediated learning intervention (M-MLI)

Design Guidelines ***(M-MLI, Cycle One)***	**Formulated Design Principles** ***(M-MLI, Cycle Two)***	**Revised Design Principles** ***(M-MLI, Cycle Three)***	**Refined Design Principles for practice**
Provide authentic contexts that reflect the way the knowledge will be used in real-life	Create an authentic mobile-mediated learning context were pre-service teachers have **access and are mobile**	Construct an authentic mobile-mediated learning context in which pre-service teachers have **access with a mobile device**	Construct an authentic mobile-mediated learning context in which pre-service teachers have access with a mobile device
Provide Authentic Tasks	Provide time for pre-service teachers to **explore** the **features** and **affordance** of the mobile technologies to mediate authentic learning	**Scaffold** the process of exploring the **features** and **affordance** of the selected technological tool	Scaffold and model the process of exploring the features and affordance of the selected technological tools for mobile-mediated learning
			Facilitate mobile-mediated learning using tools that are open, accessible, and compatible with pre-service teachers' owned devices
Multiple roles and perspectives	Engage pre-service teachers in **multiple** mobile-mediated learning **activities** to consume and produce knowledge	Engage pre-service teachers in **multiple** mobile-mediated learning **activities** that promote **metacognitive learning**	Design and scaffold multiple mobile-mediated learning activities that promote metacognitive learning
Support collaborative construction of knowledge	Provide an opportunity for pre-service teachers to use mobile-mediated learning **collaboratively**	Promote **abstract thinking** and **collaboration** among the pre-service teachers during the mobile-mediated learning experiences	Design and scaffold collaborative mobile-mediated learning context that encourages pre-service teachers' participation and peer assessment to promote abstract thinking
Promote reflection to enable abstraction to be informed	Enable pre-service teachers to **reflect on** the mobile-mediated learning experience	Enable pre-service teachers **to reflect in-action** and **on-action** on the mobile-mediated learning experiences	Design and scaffold on mobile-mediated reflective learning activities that encourage pre-service teachers to reflect in-action and on-action

11.3 Refined Design Principles for mobile-mediated learning Practice

DPs1: Construct an authentic mobile-mediated learning context in which pre-service teachers have access with a mobile device

The first critical step in creating an authentic mobile-mediated learning context is to create a learning environment that reflects how knowledge will be applied in real life (see, Herrington & Oliver, 2000 on elements of authentic learning) in which pre-service teachers have access with a mobile device. The data from all three M-MLI iteration cycles validated the importance of having an internet connection and mobile devices for mobile learning implementation. Participants, for example, mentioned that there are times when the Internet connection could frustrate them, enticing them to give up on the task. Others suggest that preparing the technological tools and internet connection ahead of time will make mobile learning more effective. Hence, the device's mobility and connectivity were important to enable participants to access mobile-mediated authentic learning activities and experiment how mobile devices could be used in real teaching and learning situations. By doing so, participants develop their own understanding and gain new knowledge of using mobile devices as a teaching tool, even for their future classroom teaching. For example, NSt5 clearly demonstrated her new attitude toward mobile learning as:

> *I will use Padlet in my future teaching as I will post all my notes or share them there, I will also create links, or pictures from websites etc. for learners who will be struggling with some activities or objectives in the subject they will be able to come to the platform and if they are shy, they can just post the voice asking questions without showing their faces or names and no one will be able to know that is them. My learners will go to the Padlet anytime they want to access the material for the subject."*

The argument developed in this study is that mobile-mediated authentic learning experiences can change pre-service teachers' attitudes and prejudices regarding mobile learning during their training. And it was argued that this could only occur when their past experiences with mobile devices are integrated with their present experiences (using Gadamer's HLE theory, see Paul, 2012; Shapcott, 2011), which may guarantee that mobile learning is acknowledged and may be adopted in their future teaching. Considering these justifications, this design principle responds to the study's research question number one (RQ1), which addresses *how pre-service teachers' past views of mobile devices influence their adoption of mobile-mediated learning experiences?* Through access and mobility of the devices via a Padlet wall, which in turn addresses

participants' historical perspectives on mobile devices and how the current experiences effect the prospective adoption of mobile learning, the construction of a mobile-mediated authentic learning context for this study clearly addresses this aspect.

DPs2: Scaffold and model the process of exploring the features and affordance of the selected technological tools for mobile-mediated learning

The authentic learning tasks implemented in this study's iterative cycles of mobile-mediated learning experiences indicated how important it is to investigate the functionalities and affordances of the chosen technological tool. According to Bower (2008), concentrating on an affordance level causes the educational designer to think more closely about the key characteristics of the technologies and how they foster collaboration and cognition, enabling choice to be made in accordance with learning outcomes. The mobile-mediated authentic learning tool's features and affordances needed to be explored, but findings from iteration 2 of M-MLI revealed that it was also essential to scaffold and demonstrate the use of the technological tool to the participants to enhance its success.

According to the participants, the educator (researcher) and one of the peers (ST8) who took part in all iterative cycles of M-MLI were perceived as role players in supporting and scaffolding learning. Participants indicated that instructors (ST8 and researcher) played a dynamic and vital role during the completion of the mobile-mediated authentic learning activities, which aided in their understanding of the task, drive their participation, and gaining of new skills and knowledge regarding the use of the selected technological tool to complete the learning tasks. For example, NST7 commented on the benefits of scaffold and affordances of the technological tool:

> *I love the fact that she (the researcher) introduced the Padlet step by step, and took me through it thoroughly. I can now say with so much pride that I know how to send audio on the Padlet. I could share my views with no one judging me as the app is user-friendly. And it doesn't take up too much space.*

Subsequently, during the implementation of iterative Cycle Three of M-MLI, understanding the affordances and features of the technological tool was found not to be enough for the effective completion of the mobile-mediated authentic learning tasks. Technical challenges that are associated with mobile devices affordances, such as connectivity and battery life; screen size and key size; the number of file/asset formats

supported by a specific device; multiple standards and screen sizes; multiple operating systems; and limited memory (Mehdipour & Zerehkafi, 2013), make and model unfolded and are found to be very critical to the adoption of mobile learning.

This design principle provided insight to my research question number four (RQ4)—*what conditions enable or constraints the implementation of mobile-mediated action learning among pre-service teachers?* This suggests that, while these processes of exploring the tool's features and affordances have been found to be very effective and critical in mobile learning, they are not without challenges, which may impede effective implementation of mobile learning experiences. Hence, this design principle cannot work in isolation. Therefore, at this point, I developed a new design principle (DPs3) that emerged from the abovementioned sentiments suggesting that educators must design mobile-mediated learning tasks using tools that are open, accessible, and compatible with students' owned devices as presented below.

DPs3: Facilitate mobile-mediated learning using tools that are open, accessible and compatible with pre-service teachers' owned devices

Results from iteration 3 of M-MLI indicated that some participants were struggling to complete certain authentic mobile-mediated learning tasks due to the technical affordances of the mobile devices that they were using. Bower (2008) defined the technical affordances of e-learning technologies as the ability to be used on multiple platforms with minimal/ubiquitous underlying technologies; the ability to adapt to connection bandwidth; and the speed and efficiency of the tool/s. For example, NST8 commented to the technology affordances and scaffolding processes on her learning experiences:

> *It was an amazing task. It made me realize that we got smartphones but we can use them to create certain tasks or videos. It was complicated though cause my phone can't accommodate some apps but through teamwork from my teammates, I was able to complete the tasks. Plus all the necessary information and instructions were given to enable us to complete the tasks.*

The Padlet (technological tool for this study) offered participants opportunities for serendipitous learning and to engage with each other to effectively completed the authentic mobile-mediated learning tasks that were given during the M-MLIs. Findings suggested that it is very crucial for the educator do develop the authentic learning activities that requires the use of the tools that are open, available, and compatible with

students' own devices. For example, the technological free tool for this study (Padlet) enabled participants to upload document and files, create voice recorder, audio recorder, using camera, drawings, embed links, YouTube links, images GIF, Spotify, use web searches, location, etc. However, Padlet was also merged with other technological tools such as google forms, Google Docs, Screen Recorder etc., which were also used to scaffold the mobile-mediated learning process.

This design principle played an important role in helping participants to obtain an in-depth understanding and knowledge of the affordances of mobile-learning technological tools as it provided them with mobility and the opportunity to apply their knowledge and skills in new and unfamiliar settings. They we also able to see Padlet as an inter-ability tool with other technologies.

When educators are examining the affordances of the various mobile-mediated learning tools, it is helpful to take into account their abilities in terms of media affordances, spatial affordances, temporal affordances, navigation affordances, emphasis affordances, synthesis affordances, access and control affordances, technical affordances, and usability (see Bower, 2008 and Chapter One). The findings also validated the importance of considering technical affordances and synthesis affordances, such as the ability to combine multiple tools to create a mixed media learning context and the extent to which tool functions and resource content can be integrated (Bower, 2008). This design principle also provided depth-insight to my research question number four (RQ4)—*what conditions enable or constraints the implementation of mobile-mediated action learning among pre-service teachers?*

DPs4: Design and scaffold multiple mobile-mediated learning activities that promote metacognitive learning

Along with the need for the participants to understand and explore the use of the mobile-mediated technological tools for learning, this design principle enabled participants to participate in various mobile-mediated learning activities which provided them with mobility and the opportunity to apply their knowledge and skills in various new and unfamiliar contexts.

Research revealed that proving participants with multiple mobile-mediated authentic tasks such as creating websites and YouTube channels, uploading subject teaching

material to their websites, creating audio recorders, video recorders, share links to etc. was relevant and enable participants to be engaged in multiple perspective and practices of mobile learning. The opportunity to explore the mobile-mediated learning task from multiple perspectives allowed participants to acquire new knowledge and construct their own understanding. For example, NSt9 appreciated her involvement in multiple tasks by stating that "more and more every day I keep on learning new skills on the Padlet and it's really broadening my knowledge". Findings from iteration 3 of M-MLI revealed that scaffolding the process of multiple perspectives

Coulson and Harvey (2013) advise educators that it requires various perspectives to challenge students' beliefs, values, and presumptions as well as cultural and other conventions of which they need to be aware of in order to function effectively in their new environment. They further emphasize that assisting students in recognizing their values, assumptions, and beliefs in relation to the experience will help them become more metacognitive conscious, which will lead to deeper levels of reflection and learning. From this point of view, it can be argued that designing and scaffolding multiple mobile-mediated learning activities to enhance pre-service teachers' metacognitive (an awareness and ability to analyses one's learning or thinking processes (Paris & Winograd, 2003) learning is imperative in mobile learning. These sentiments provided as insight to my research question number 4 (RQ4) again illustrating on *what conditions enable or constraint the mobile-mediated action learning among the pre-service teachers*?

DPs5: Design collaborative mobile-mediated learning context that encourages students' participation and peer assessment to promote abstract thinking

With the help of this design principle, participants and the researcher (educator) could collaborate more effectively, allowing the participants to seek scaffold and directions when needed while allowing the educator to provide feedback and guidance when necessary. Findings indicated that collaborative authentic mobile-learning tasks (such as peer assessment, participants commenting on each other's work, completing each other's questionnaires, and guiding each other to complete a task) enhanced participants' activeness, enabled integrated mobile learning, and encouraged collaboration between peers and the educator.

As part of the mobile-mediated authentic learning design, participants appreciated the share knowledge and guidance that they received from their peers and the educator. Most importantly, the intentionally designed collaborative learning context during iteration 3 of M-MLI to promote abstract thinking did appear to serve the purpose of helping participants to become critically self-aware through different enablers— peer assessment, creating of course websites and helping identify strengths and weaknesses for creating innovative knowledge. On the other hand, it also provided participants with alternative learning perspective that promoted abstract thinking improved their understanding. This design principle was also pertinent to enable participants to seek scaffolds for learning through connectivity, interactions across, peer assessment, sharing ideas, inquiry, problem solving, and collaboration with peers and educator (researcher) via Padlet. For example, NSt7 encapsulated on how she learnt from others that:

> *I had to go through my colleague's website, and I must say going through it, I learned a few things that could help me adjust my website…some of my colleagues' websites were so knowledgeable and eye-catching, that they out-did their layout as it was simply fantastic. We also had to comment on each other's work… Am honestly enjoying every part of this Padlet journey* ♡ 🤩 *(NSt7, PRJ).*

This design principle helped me to contextualize and respond to research question 3 (RQ3): How does pre-service teachers' dialogue with peers, in a mobile-mediated action-learning environment, change dispositions? In support of this view, Jacobs (2014) postulated that it is important to explore students' experiences through conversations within oneself (self-assessment), text (*students' artefacts*), artworks (websites) and those of others (peer-assessment) to encounter a new experience and new meanings. In correspondence to the RQ3, participants were engaged in a dialogue to reflect on their past and what they are currently experiencing in collaboration with peers, with the expectation of making sense of each other to capture or create new meanings, which in turn changed their disposition towards mobile learning.

DPs6: Design mobile-mediated reflective learning activities that encourage students to reflect in-action and on-action

The design principal feature to instantiate reflection as an element of authentic learning was an authentic task to enable participants to reflect in an engaging and intentional mobile-mediated learning environment. This enabled reflection in-action and on-action, both as an individual and as a group among the participants on their mobile-mediated

learning experiences. The reflective authentic tasks done through the development of the pre-evaluation questionnaires, PRJ after the completion of each authentic mobile-mediated learning task (reflect in-action) as well as post-evaluation questionnaires or discussion forum at the end of the whole iterative cycle of M-MLI (reflect on-action).

The development of the reflective authentic tasks were guided by the first two levels of the Kirkpatrick Evaluation Model (Kirkpatrick & Kirkpatrick, 2019) to evaluate the M-MLI during Phase Three (DBR) of testing and refinement of the solution for each iterative cycle of M-MLI (see Chapter Seven). This was deemed necessary with the aim of evaluating the process of authentic tasks and providing opportunities for participants to reflect in-action and on-action. The guiding reflective questions were aligned with the first two levels (levels 1 and 2) of the Kirkpatrick Model to guide the process of evaluating and assessing the mobile-mediated learning experiences for this study as follows: (a) *Level 1 Reaction (reflect in-action)***:** To what degree do pre-service teachers react favourably to the mobile-mediated learning experience? How did the mobile-mediated learning experience make them feel? (b) *Level 2 Learning (reflect on-action)***:** To what degree did pre-service teachers acquire the intended knowledge, skills, and attitudes based on their participation in the mobile mediated learning experience? Did they learn how to use mobile devices to mediate learning? What worked? What did not work? What did they like? What did they not enjoy?

Subsequently, all participants in all iterative cycles of M-MLI were given opportunities to reflect before (pre-evaluation questionnaires), during (PRJ) and after (post-evaluation questionnaire, developed reflective tasks and forum discussion) each learning experience. The findings suggest that reflective tasks enable participants to self-reflect, make sense, and derive meaning from their mobile learning experiences. Each participant shared their views and reflected on their experiences, new skills and knowledge acquired, and how they predicted what their future classroom teaching with mobile devices would look like. For example, two participants clearly commented on the whole process of their mobile-mediated authentic learning experiences such as the effectiveness of collaboration, scaffolding, affordances, process of authentic learning, what they enjoyed, challenges by writing on the PRJ that:

> *I learned a lot on this journey, and I challenged my capabilities. For every task that was given to us, we have cleared instructions and we were given adequate time to complete each task. It was really fun as we engaged pretty well with my colleagues which made everything else easier. What I enjoyed most was*

explaining how to use the audio recorder and GIF on the Padlet. I did a whole tutorial video on these features. I also had fun creating my website….. I honestly enjoyed every part of this adventurous journey as I learned a lot from it. I would really recommend that they make use of the Padlet in the academic journey (NSt7, PRJ3)

The overall experience was very educational. The set of instructions was really simplified and clearly indicated. What was unpleasant is that the Padlet required a phone with updated software. Some features were not supported on my phone (NSt5, PRJ3)

This design principle provided participants with the ability to critically reflect, through which their values, beliefs, past views, and assumptions, were challenged and transformed through the present experiential learning which may influence changes in disposition towards mobile learning. Paris and Winograd (2003) noted that critical reflection has been connected to higher order cognitive processes such as self-regulation (a learner's ability to manage their learning) and metacognition. This design principle enabled me to understand and respond to research questions (RQ) 2 and (RQ) 4: RQ2: *What type of reflection on-action and in-action do pre-service teachers do when engaged in mobile-mediated action learning?* RQ4: *What conditions enable or constraint the mobile-mediated action learning among the pre-service teachers?*

11.4 Chapter Summary

In this chapter, I have highlighted the retrospective analysis of the data produced from each phase of DBR of this study. Reflection on each DBR phases and the produced design principles emerged from this was presented, representing Phase Four of DBR. Refinement of the mobile-mediated learning design principles was articulated and, as a result, a mobile-mediated action learning framework (M-MALF) for pre-service teacher to improve their position in teaching and learning with technology was refined. The following chapter twelve concludes this study and provides recommendation for future research.

CHAPTER 12: THESIS CONTRIBUTION AND CONCLUSION

12.1 Chapter Overview

This chapter concludes the study. It begins by providing a brief review of the entire research process, research questions, and how they were aligned to the design principles of mobile-mediated learning experiences and theoretical aspects. It then explains the contribution of the study in terms of theoretical contribution, practical contribution, pedagogical contribution, and methodological contribution. It also discusses the validity and reliability of the study. Finally, the chapter ends with a conclusion and recommendations for proposed future research.

12.2 Reflection on the research processes and research questions

My research goal was to create a Mobile-Mediated Action Learning Framework (M-MALF) for pre-service teachers' training that would be mediated by a mobile learning experience wrapped with reflections. The research problem was founded on the fact that one of the grey areas emerging around mobile learning is the development of a mobile learning pedagogical and theoretical framework that can guide teacher training (for this study, pre-service teachers) on how to use mobile devices as a teaching and learning tool, particularly in the Namibian context.

My personal background as a lecturer and a Dean of the Faculty with the assistance of reading journal articles on mobile learning has contributed and opened my eyes to how I have been technically limiting myself to only teaching my students about technologies instead of teaching them with technologies. My passion for educational technologies and innovative teaching shaped my thinking about exploring the potential of mobile devices in teaching and learning. It is against this background that I have decided to engage myself in this research and study more about educational technologies, focusing on mobile learning.

The main question addressed in this study was: In what ways does mobile-mediated action learning shift pre-service teachers' dispositions to adopt mobile learning pedagogies into their practice? The presumptive perspective of this study was based on the idea that if a future teacher (pre-service teachers) could participate in mobile-mediated action learning, which is more likely to inform their future classroom teaching, then adoption of mobile learning (m-learning) as a teaching method could be effective. That being stated, this study hopes to make a significant contribution to educational

planning in Namibia and beyond by outlining practical and efficient ways to include mobile learning into teacher education.

In **Chapter 1,** I presented a general outlay of the processes followed towards the design of a Mobile-Mediated Learning Invention (M-MLI) for pre-service teachers. First, I introduced the study, followed by the research aims and objectives. The theoretical constructs, literature reviews, and fact-finding studies were used to frame the research questions and sub-questions (see Chapters Three, Four, Five and Six). The rationale of the study, which described my positionality in the study, a brief overview of the demand for emerging technologies in a 21st century classroom, as well as an overview of mobile learning, was presented. It also provides a general overview of the Design-Based Research (DBR) methodology. Finally, I concluded the chapter by providing the tabular structure of the thesis and the definitions of concepts that were employed throughout the study.

In **Chapter 2,** I presented the research methodology of this study, where I explained the research design, characteristics, and justification for engaging with the DBR, which represent the research methodology aspect of this study. As a result, I presented the four phases of DBR, including the process of each iteration, participants, data collection procedures, and a description of data analysis. The epistemology chosen for this study was also discussed in this chapter. This study adopted a constructivism philosophical paradigm that asserts that people construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences (Adom et al., 2016). This study also adopted the interpretative phenomenological analysis (IPA) to explore in detail how participants were making sense of their personal and social worlds during their mobile learning experiences. The chapter concluded by demonstrating the ethical consideration for this study.

In **Chapter 3** I discussed the revolution of emerging technologies in pedagogy and the background of mobile learning, which is a key concept in this study. While in **Chapter 4** I discussed the literature review from the Namibian context where this study was based. All these were regarded as a process of reviewing literature (following the DBR Phase One) in the context of mobile learning and the theoretical aspects associated with it.

In **Chapter 5,** I discussed findings from the fact-finding study that was primarily conducted to identify and investigate the significant educational problems and challenges evolving around mobile learning in collaboration with the researcher and practitioners. Here, I first discussed the findings from the web-link questionnaire, which was administered to the third-year pre-service teachers doing Bachelor of Education honours in secondary. Secondly, I presented findings from interviews with educators from the same field to explore the research problem. These findings informed the framing of the research question and the research problem.

In **Chapter 6** I describe the theoretical and conceptual framework that was guided by two theories: Hermeneutic Learning Experience (HLE) Theory and Action Learning (AL) Theory, which were repeatedly employed throughout the study. The theoretical and conceptual framework helped me to understand the strategies of the mobile learning field, the process of mediating learning through mobile devices, as well as the magnitude of scaffolding and reflection it requires.

In **Chapter 7,** I discussed how I developed the learning solution (following Phase Two of DBR) informed by the existing design guidelines from the literature. According to DBR, to create a solution, the researcher must consult literature to find relevant theories that can guide thinking as well as locate the existing design guidelines that may have addressed a similar problem. Informed by Herrington et al.'s (2010) nine elements of authentic learning, five elements of authentic learning were adopted to guide the solution and development of mobile-mediated learning authentic context for this study.

In **Chapters 8–10, I** described the iterative design, implementation, and formative evaluation of three iterations of mobile-mediated learning experiences (following DBR Phase Three). The DBR phases and iterative cycles of the M-MLI process are clearly explained in **Chapter 10.** I also explained the emerging design principles of mobile-mediated learning that emerged from this study in Chapter ten. In **Chapter 11**, I concluded and explained the contribution of this study.

The following discussion presents how the main question and sub-questions of this study were addressed.

A primary question for this study is:

In what ways does mobile-mediated action learning shift pre-service teachers' dispositions to adopt mobile learning pedagogies into their practice?

From this primary question, and after reviewing of the literature, four sub-research questions (RQs) emerged and are respectively reviewed, to show how each question was answered in the study.

> *RQ1: How does pre-service teachers' past view on mobile devices impact adoption for mobile-mediated action learning?*

During the initial fact-finding study (see Chapter Five) to investigate the practical research problem, I discovered that educators' and pre-service teachers' prior views (see Chapter Six on hermeneutics) and prejudices against mobile devices as not a suitable tool for teaching and learning needed to be addressed for mobile learning to be adopted. This led to a more refined sub-research question 1 (RQ1). As a result, during the implementation of M-MLI iterations, pre-evaluation and post-evaluation questionnaires were administered for each iterative cycle (as discussed in Chapters Eight, Nine, and Ten), which helped me to understand the process of how the participants adopted and changed dispositions towards mobile learning. The design principles (DPs) that emerged during this process are:

DPs1: Construct an authentic mobile-mediated learning context in which students have access with a mobile device

DPs2: Scaffold and model the process of exploring the features and affordance of the selected technological tools for mobile-mediated learning

> *RQ2: What type of reflection on-action and in-action do pre-service teachers do when engaged in mobile-mediated action learning?*

Sub-research question 2 (RQ2) was based more on the practical aspects of action learning, which provided participants with the opportunity to return to the experience or past views, attend to feelings, and re-evaluate the experience through reflection. I therefore decided to adopt the elements of authentic learning as guiding principles (see Chapter Seven), which enable participants to practice and reflect on the way mobile learning can ultimately be used in real life. As a result, Progress Report Journals (PRJ) was maintained during each iterative cycle of mobile-mediated learning, which enabled

participants to record and reflect on their experiences for each task and iterative cycle completed. During this process, the following design principle emerged:

DPs6: Design mobile-mediated reflective learning activities that encourage students to reflect in-action and on-action

> *RQ3: How does pre-service teachers' dialogue with peers, in a mobile-mediated action learning environment, change dispositions?*

During the implementation of the design solution for this study, it was deemed necessary to understand how questioning and group discussion (dialogue) addressed the prejudice and biases among pre-service teachers during mobile-mediated learning experiences. To understand how the change in disposition was achieved through dialogue (to respond to RQ3), I developed mobile-mediated learning tasks (see Chapters Eight, Nine, and Ten) that required collaborative participation and discussion among the pre-service teachers. When all these were present, participants appreciated others' contributions and felt that it contributed to their understanding and changed their disposition towards mobile learning. Here the following design principles emerged:

DPs5: Design collaborative mobile-mediated learning context that encourages students' participation and peer assessment to promote abstract thinking

> *RQ4: What conditions enable or constraint the mobile-mediated action learning among the pre-service teachers?*

The whole process of DBR that enabled the refinement of the initial design guidelines into revised guidelines and finally the refined design principles for mobile-mediated learning experiences provided an answer to the last sub-question 4 (RQ4). The refinement of the initial guiding principles illustrates what constraints prevented or enabled effective implementation of mobile-mediated learning experiences among pre-service teachers. A lack of open, accessible, and tools that are not compatible with owned mobile devices was identified as a challenge that may constrain the process of mobile learning experiences during the implementation of M-MLIs. However, it was also identified that the success of mobile-mediated learning experiences can be possible if there are multiple tasks provided and continuous scaffolding by the educator or instructor. As a result, the two final design principles emerged:

DPs3: Facilitate mobile-mediated learning using tools that are open, accessible and compatible with students' owned devices

DPs4: Design and scaffold multiple mobile-mediated learning activities that promote metacognitive learning

12.3 Contribution of the study moving towards mobile-mediated action learning

The study makes both theoretical, practical contributions, pedagogical and methodological contributions.

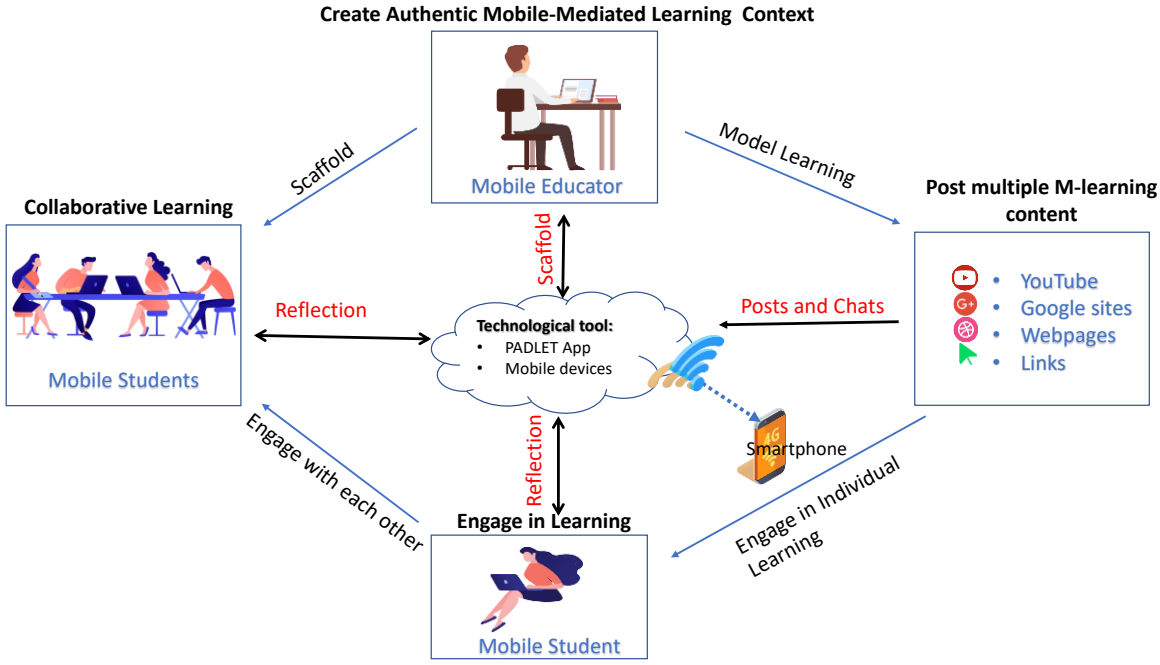
12.3.1 Pedagogical contribution of the research

The recommended pedagogical framework for mobile-mediated learning for pre-service teachers is depicted diagrammatically (Figure 12.1). I developed this framework as a guiding tool that could be used to assist pre-service teachers in understanding and conceptualizing the use of mobile devices in teaching and learning (teaching with mobile devices). They must be introduced, modelled, and scaffolded in the acquisition of self-driven and determined learning abilities and knowledge (Canning, 2010). For this study, I build on DBR (methodology), hermeneutics learning experience (theory from the abstract world), action learning (theory from the practical world), the Triadic Zone of Proximal (what students can do without assistance and what students can do with assistance), the Personal Learning Environment (setting of authentic learning context), and Kirkpatrick's Evaluation Model (analysing and evaluating the intervention) to develop the pedagogical framework of this study.

Based on Figure 12.1 processes, it was possible to construct and model a mobile-mediated action learning framework involving a mobile educator (author), an expert or practitioners, mobile students (pre-service teachers), a mobile device, and a specific technological tool or application (Padlet, used in this study). The chosen technological tool, Padlet, functions as a platform that facilitates individual or collaborative learning for mobile students through features like posts and chats. This allows them to seek scaffold, collaborate with knowledgeable individuals, and develop mobile learning skills through various activities and reflections using mobile learning resources such as YouTube, Google sites, links, and websites. This integration capitalizes on the advantages offered by mobile devices in teaching and learning. The resulting framework, named the Mobile-Mediated Action Learning Framework (M-MALF), is presented in Figure 12.1, representing the outcomes of this study.

Figure 12.1

Diagrammatic representation of the Mobile-Mediated Action Learning Framework (M-MALF)



Once a pedagogical framework for mobile-mediated learning context (M-MALF) has been developed and the design principles or guidelines for mobile-mediated learning could be used to guide the implementation of a mobile-mediated learning course by coordinating, scaffolding, supporting, and modelling the learning and use of technology that students can access on their devices. The following components were used to create and deploy a mobile authentic action learning environment for this study:

- A course webpage platform (Padlet)
- Pre-evaluation tasks or assessment
- Progress report journal
- Instructional videos on how to use the mobile devices tools or complete a task
- Exemplar artefacts of the use of mobile devices in teaching and learning
- Post evaluation tasks or assessment

As a result, table 12.1 below present how the refined design principles emerged from this study could be implemented in a mobile learning course.

Table 12.1

Design Principles for Mobile-Mediated Learning

Design Principles (DPs) for mobile-mediated learning	Meaning	How the principles could be implemented in the mobile-learning course
DPs1: Construct an authentic mobile-mediated learning context in which students have access with a mobile device	*Access:* Students must have access to internet connectivity or WIFI and/or mobile network coverage	Create an authentic mobile-mediated learning context by ensuring students have access to internet connectivity and a mobile device; choose a technological tool to mediated learning; develop a tutorial video explaining the process, methods and aims of the lesson
	Mobile: Students must own a smart mobile phone or related devices. Set tasks that are real-world, relevance and ill-defined that can be completed by students anywhere, anytime.	
DPs2: Scaffold and model the process of exploring the features and affordance of the selected technological tools for mobile-mediated learning	*Scaffold:* a clear guidance and modelling of the use of the chosen technological tool must be given to the students on an on-going basis.	Allow students to explore the features and affordances of the selected technological tool; Modell and scaffold the uses and features of the tool
	Features: the features and functionality of the chosen tool should be modelled and explained to the students	
	Affordance: the technological affordance should be matched with the designed mobile-mediated learning tasks. Enabling student mobility and engagement in learning contexts and able to construct context for learning	
DPs3: Facilitate mobile-mediated learning using tools that are open, accessible and compatible with students' owned devices	*Open:* The facilitation of mobile-mediated learning should consider technological tools or applications that are open and freely available e.g., use apps that are free on google play or App store or free downloaded	Blend the selected technological tool with other mobile Apps that are free downloaded, and compatible with their devices such as web-based, build-in apps, has multiple educational features, easy to navigate and interact with electronic, apps that are supported by all operating system such as Android, iOS, Windows phone OS, Symbian and others
	Accessibility: The facilitation of mobile-mediated learning should consider technological tools or applications that are accessible to students	
	Compatibility: The facilitation of mobile-mediated learning should consider technological tools or applications that are compatible and user friendly with students owned devices.	

DPs4: Design and scaffold multiple mobile-mediated learning activities that promote metacognitive learning	Design authentic tasks that enable Students to seek scaffolds for learning through collaboration with peers and educator in a learning environment. Allow opportunity for students to crisscross the learning environment. Enable different perspectives on the topic or subject from various e-learning perspectives.	Allow students to practice mobile learning activities from different perspectives such as designing own website pages for their subjects, create own YouTube channels, embed google sites, links and blend a chosen technological tool with other mobile apps or features etc.
DPs5: Design collaborative mobile-mediated learning context that encourages students' participation and peer assessment to promote abstract thinking	*Peer assessment:* The design of collaborative task should consider peer assessment to enable sharing of ideas, inquiry, feedback and problem solving among the students.	Allow for collaborations through peer engagement and assessment such as view each other's work and comments, assess others work, provide guidelines and procedures for peer assessment.
	Abstract thinking: Develop tasks that are completed in pairs or groups work through linkages, connections and interactions among the students, enabling abstract thinking.	
DPs6: Design mobile-mediated learning reflective activities that encourage students to reflect in-action and on-action	*Reflect in-action:* Create reflective tasks that enable students to make sense of their experience after the lesson enabling them to develop meaning from their experience. Generate options for documenting learning after each lesson.	Allow students to reflect before, during and after the lesson such as create an online reflective journal, give formative assessment tasks and feedback, give summative assessment and feedback, give post-evaluation self-assessment etc.
	Reflect on-action: design reflective tasks that provides students with opportunity to return to their experiences for the whole learning context, attend to feelings and re-evaluating the experiences.	

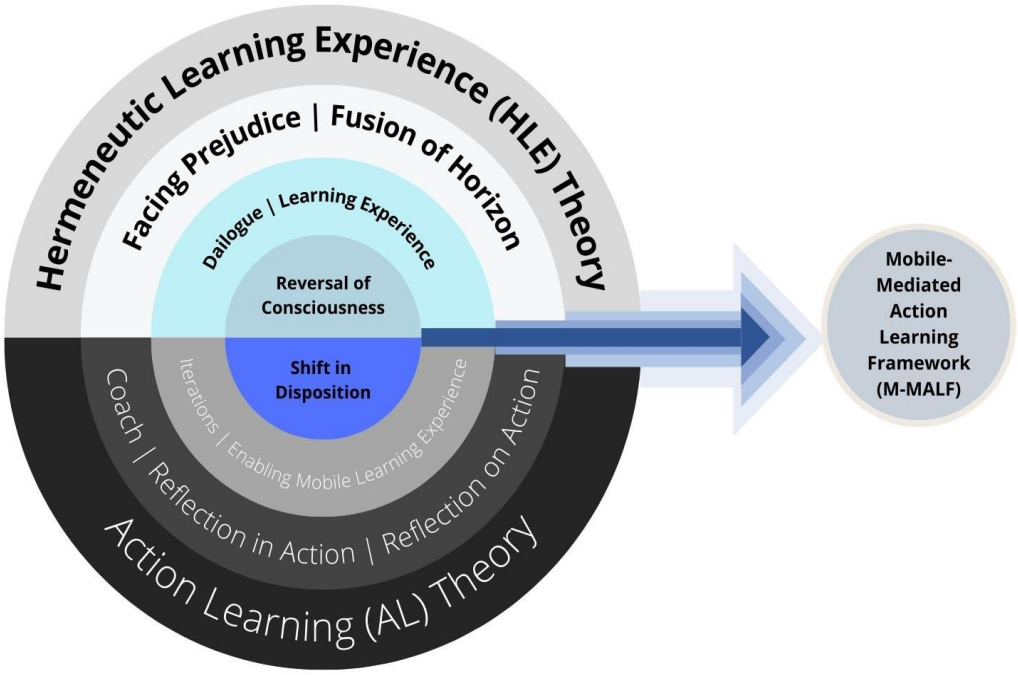
12.3.2 Theoretical contribution of the research

The theoretical contribution of this study lies in the merging of Action Learning (AL) theory and Hermeneutic Learning Experience (HLE) Theory to develop an experiential mobile-mediated learning experience for pre-service teachers (Figure 12.2). Hermeneutic phenomenology has been employed in several studies to acquire understanding in education (Fleming et al., 2003; Geanellos, 2000; Paul, 2012), but none of these authors used HLE to develop a M-MLI for pre-service teachers. Similarly, action learning gave pre-service teachers a chance to engage in mobile-mediated

action learning, which enabled them to reflect on their past mobile device experiences in order to make sense of their present learning environment.

Figure 12.2

Theoretical framework for the Mobile-Mediated Learning Intervention



It was evident throughout the study that the theoretical concept HLE from the abstract world played out in the practical theory (AL) from the physical world during the M-MLI for this study. It is argued that prospective teachers must be engaged in action-learning that is wrapped in reflection so that they can reflect on the different perspectives of the past and contextualize them in the present to reach meaningful conclusions about mobile learning.

The theoretical framework of this study emerged from the Gadamerian theory of HLE (see McManus Holroyd, 2007) and Revans' (1980) action learning (AL) theory (see Ferguson et al., 2019) as illustrated in the first big outer circle of figure 12.2 above which illustrates the theoretical and pedagogical theory of this study. The pie chart (Figure 12.2) is divided into two parts, the top part represents the abstract world (HLE theory) of the study, and the bottom part represents the physical (practical) world (AL theory) of the study.

The third circle represents the actual practices of learning experiences that allow pre-service teachers' mental consciousness to play out. This can be accessed via dialogue (within oneself and with others), coaching, reflection in- action, and on-action during iterations. At this point, mobile-mediated action learning experiences will play out in the physical world, and the pre-service teacher may begin to see the potential of mobile devices in the real world. As a result, their disposition towards mobile devices is likely to shift. The last inner circle represents the research questions for the study. It is aimed at understanding how the hermeneutic mobile-mediated learning experiences diffuse horizons to shift dispositions, which will be evidence of a reversal of consciousness among pre-service teachers. This represents how mobile-mediated learning pedagogical experiences transform the understanding of pre-service teachers towards mobile devices as teaching and learning tools, which is the objective of this study.

Following the DBR phases (the chosen methodological approach for this study), Phase Three offered a foundation for operationalizing theoretical notions as well as the five elements of authentic learning that guided the development of design guidelines enabling mobile-mediated learning experiences. Furthermore, DBR represents action learning in the sense that it was utilized to implement the theoretical and practical constructs in a physical space. As a result, the design guidelines were tested, refined, and reflected on in practice as a pedagogical framework that might be employed in future mobile learning research and implementation.

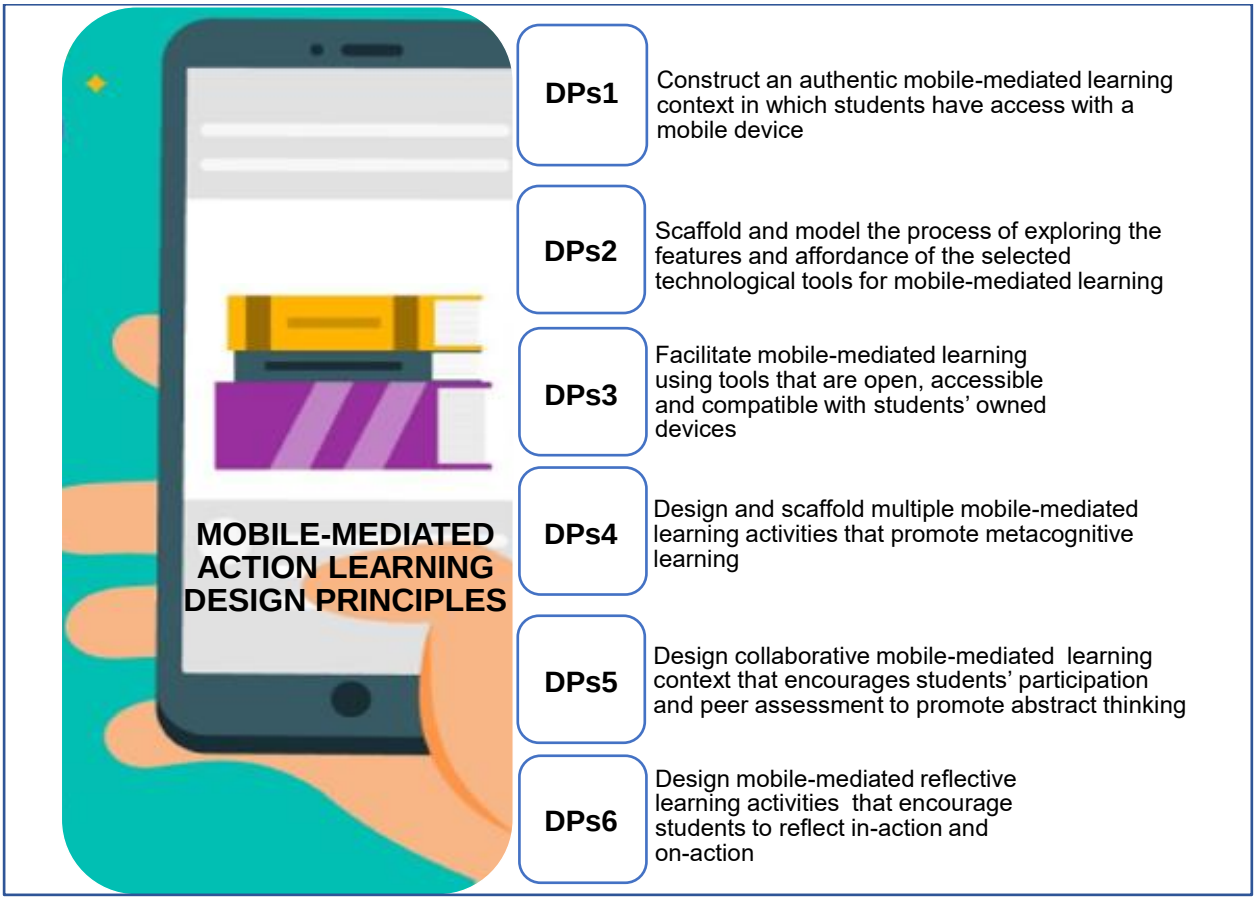
By revealing participants' searches for scaffolds, dialogue, artifact creation, and participation in the educator's role (see Figure 12.1), the study also contributes to the framing of mobile-mediated learning authentic tasks mediated via a Padlet wall. The five elements of authentic learning guided the three cycles of M-MLI iterations. However, the names of the elements of authentic learning were renamed after each iterative cycle to fit them with mobile-mediated learning and study findings (see Chapters Eight, Nine, and Ten). Each M-MLI iterative cycle incorporates the notions of dialogue (collaboration), addressing bias, activating horizon fusion (past experiences linked to present experiences), and consciousness reversal through the process of learning experiences.

12.3.3 Practical contribution of the research

This study also makes a practical contribution. To assess the impact of the process and framework on a personal level, I reflected on the comments on the way in which the participants perceived themselves and others after the M-MLI and the design principles that unfolded.

Figure 12.3

Mobile-Mediated Action Learning (M-MAL) Design Principles



The design principles outlined here represent the study's major theoretical and practical contribution to existing knowledge of mobile learning. The current design principles are particularly written with regards to the mobile-mediated action learning for pre-service teachers and are not generically applicable to the broader field of mobile learning. The purpose of this study is not only to create a mobile-mediated learning framework for pre-service teachers only but also to find a way to integrate contemporary mobile devices in various context.

For the Design Principles (DPs) to be relevant to a wider audience, the contextual elements of the mobile-mediated are removed in a final refinement of Design Principles (DPs) for mobile learning and they read as follows:

> **DPs 1:** Construct an authentic learning context in which students have access with a mobile device
>
> **DPs2**: Scaffold and model the process of exploring the features and affordance of the selected technological tools
>
> **DPs3:** Facilitate mobile learning using tools that are open, accessible and compatible with students' owned devices
>
> **DPs4**: Design and scaffold multiple learning activities that promote metacognitive learning
>
> **DPs5:** Design collaborative learning context that encourages students' participation and peer assessment to promote abstract thinking
>
> **DPs6:** Design reflective events that encourage students to reflect in-action and on-action

Design principles emerged from this study offered a simplified process of integrating mobile devices into teaching and learning, with a focus on the development of M-MLIs for pre-service teachers. As a result, it is advised that higher education institutions strategically incorporate and promote mobile learning into their teacher education curriculum focused on pedagogy using mobile device tools. This is due to possibilities for collaborative interaction and practical experience in a deeper exploration of mobile devices and their value in pedagogy being provided to pre-service teachers. Subsequently, pre-service teachers will be exposed to innovative ideas and practices that aid in the pedagogical integration of mobile devices into teaching and learning, culminating in the formation of a critical mass of individuals capable of providing quality education using technologies. This integration enables educators to access contemporary educational resources, digital textbooks, and online learning platforms, ensuring that their teaching practices remain up-to-date and relevant.

Moreover, in the twenty-first century, educators have the opportunity to incorporate mobile devices into their pedagogical practices, enabling them to play a significant role in delivering high-quality and lifelong education in line with Namibia's educational transformation goals. Simultaneously, this integration contributes to the achievement of the United Nations Sustainable Development Goals (SDGs), which encompass a wide

array of global objectives, including the promotion of quality education (SDG 4). By incorporating mobile devices into their teaching approaches, educators actively contribute to the fulfillment of SDG 4, as they are able to provide education that is inclusive, equitable, and of high quality. Ultimately, by embracing mobile learning, educators can leverage the power of technology to foster transformative learning experiences that positively influence students' educational journeys and align with broader global education agendas.

12.4 Limitations of the thesis

One limitation of this study is that it is a subset of a much broader study and, as such, cannot draw on the complete context of the mobile-mediated learning environment among pre-service teachers. Nonetheless, limiting the study has advantages in that Design Based Research (DBR) was used and three different cycles of intervention were carried out to test and re-test the designed solution, allowing the research problem to be explored in depth (see Chapter Two). Furthermore, the limited number of participants in this study may not be typical of the general position of all pre-service teachers at the International University of Management (IUM). The mitigation here was that using different cohorts of students in different years of their studies, as well as testing the designed solution with different groups of participants, was advantageous in improving the ability to develop design principles that could be used to guide pre-service teachers' mobile learning pedagogical experiences in a broader context.

Another limitation of this study was a conflict of interest on my part, as I was both a researcher and a Dean of the Faculty, doing a study with my own students. This may have hindered participants' ability to fully engage in the discussion as they may have been afraid that their negative feelings and perceptions would be used against them. Here, a deliberate decision was made by nominating previous iterative mobile-mediated learning cycle participants to play a prominent role as educators while I monitored and provided support and advice. This decision was made to assure participant that this was a collaborative work for educational purposed only and data were used to understand and not judge their practice of pedagogical integration of mobile learning which enabled them to be free. Participants were also told that their involvement was entirely voluntary and that decline or withdrawal from participation would result in no consequences.

12.5 Recommendations for further research

Further research will be conducted to determine the transferability and usefulness of the design principles derived in this study in various contexts, as well as how they may inform the development and implementation of a curriculum in collaboration with teachers, educators, and IT practitioners. Additional, study could take a holistic view of educators, enact the pedagogical aspect of mobile learning in teacher education, and measure the impact of mobile-mediated learning based on educator outcomes, to identify dispositions that may impact their integration of mobile learning in their classroom when training pre-service teachers. On the other hand, the emphasis of study focused only in five guiding elements of authentic learning elements rather than the nine guiding principles as defined by Herrington et al., (2010), other authentic learning elements beside the five focused on in this study may be employed in future research to develop the design learning solution for mobile-mediated learning for pre-service teachers.

12.6 Chapter Summary and final words

This chapter concludes this study by outlining its contribution both to the theoretical, pedagogical, and practical aspects. While DBR adds to both theory and practice, the mobile-mediated learning design principles outlined here represent the study's major theoretical and practical contribution to existing knowledge of mobile learning. This study specifically focused on providing the refined design principles elicited from the four-year study that have the potential to influence the practice of mobile learning in teacher education. It is hoped that the design principles here can guide other practitioners who are in turn be able to build on them and share their own experiences and knowledge, further enhancing and informing the use of mobile devices in learning and teaching. To that end, I must mention that the proposed mobile-mediated action learning framework (M-MALF) was successfully constructed in this study.

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APPENDICES

Appendix A: Questionnaire for fact-finding study among pre-service teachers

A fact-finding study on mobile learning among Pre-service teachers (student-teachers) at IUM

Dear IUM Bachelor of Education in Secondary Third Year Students,

You are being invited to participate in a research survey on mobile learning among pre-service teachers (student-teacher) at the International University of Management (IUM), Namibia. This research study is being undertaken as part of my Doctoral research in Education at the University of Cape Town, South Africa. The aim of this research survey is to understand your views and experiences of using Mobile Devices in your studies. You are chosen to participate in this survey because you are a third-year student-teacher doing Bachelor of Education Secondary Honours in 2020 at IUM.

The following conditions will be met:
1. Your participation in this study is voluntary. You have the right to refuse to participate or withdraw from this study, at any time should you wish to do so.
2. Your name will not be revealed to anyone either verbally or in written form in the thesis or anywhere else. Pseudonyms (different names) will be used for all participants in the writing up of the research.
3. You are only invited to complete an online questionnaire attached to this form to collect data for Phase 1 of this research study.
4. The questionnaire is divided into four sections, consisting of close-ended and open-ended questions which will take approximately 10 minutes to complete.
5. Be assured that refusal to participate in this study will not lead to any consequences or affect your study/marks in any way as your lecturer.
6. You are kindly requested to be accurate and honest as much as possible when answering the questions. The data will only be used for academic purposes.
7. Please feel free to contact me for further information regarding this study via email or telephone: ndeunyema@gmail.com or +264811488187.

If you are interested in participating in this research study kindly select a YES column below and complete the form to indicate your consent for the research, and after you have completed the consent form, go ahead and complete a questionnaire.

if you are not interested please select a No column below and exit the form.

Your participation is greatly appreciated.
Kind Regards,
Alpha Ndeunyema

*Required

1. Do you agree to participate in this research study? *

   Mark only one oval.

   - ◯ YES *Skip to question 2*
   - ◯ NO

Consent Form- for students' who agreed to participate in the research

Please complete the consent form below to indicate your consent for this research and once done please on the next sections to complete the questionnaire.

2. Your Name *

_____

3. Your Email Address *

_____

4. Please tick all that apply *

   Tick all that apply.

   - ☐ I confirm that I have read and understand the information above
   - ☐ I consent to complete the quetionnare about my mobile learning experience
   - ☐ I agree that my response may be stored securely and confidentially
   - ☐ I consent that my partcipation/ responses in this study will not affect my study
   - ☐ I understand that my participation is voluntary and that I am free to withdraw at any time without penalty
   - ☐ I agree to participate in this study

A fact-finding study on mobile learning among Pre-service teachers (student-teachers) at IUM: Research Quetionnare for the student teachers

Dear participant,

Thank you for agreeing to participate in this research survey. You are kindly requested to be accurate and honest as much as possible when answering the questions. The anonymity and confidentiality of your participation in this survey will be highly maintained and the data will only be used for academic purposes. Please answer all the questions follows. Thank you.

5. What is your gender? *

Mark only one oval.

- Female
- Male

6. What is your age group?

Mark only one oval.

- 15-19
- 20-29
- 30-39
- 40-49
- 50 and above

7. What is your area specialization as a student-teacher? *

Mark only one oval.

- Commerce
- Science
- Language
- Social Science

8. What type of mobile device do you own? *

Please tick all that apply

Tick all that apply.

- [ ] Laptop
- [ ] Smartphone
- [ ] Tablet
- [ ] iPad
- [ ] None of the above
- [ ] Other: _____

9. Do you use your smartphone for academic purposes *

Mark only one oval.

- ◯ YES
- ◯ NO
- ◯ I do not have a Smartphone

10. Indicate on the scale, how often do you use each of the devices listed below * for your assignments and academic work

Mark only one oval per row.

	Not Used at all	Least Used	Moderately Used	Most Used	Always Used
Smartphone	◯	◯	◯	◯	◯
Desktop PC	◯	◯	◯	◯	◯
Laptop	◯	◯	◯	◯	◯
iPad	◯	◯	◯	◯	◯
Tablet	◯	◯	◯	◯	◯

11. Indicate on the scale, to what extent each of the following scenarios corresponds with how you access your online learning materials *

Mark only one oval per row.

	Does not correspond at all	Correspond a little	Correspond moderately	Correspond a lot	Corresp exactl
By using my Smartphone/Tablet/iPad					
By using my Laptop/Destop PC					
By using my friend's/classmate's phone					
By using my friend's/classmate's /parents/relative's laptop/desktop PC					

12. Indicate on the scale, to what extent each of the following scenarios corresponds with the educational activities that you do with your mobile phone on a daily basis *

Mark only one oval per row.

	Does not correspond at all	Correspond a little	Correspond moderately	Correspond a lot	Correspond exactly
Communicate with my classmates/other students on WhatsApp					
Access the Google Search engine to complete my assignments					
Access an online library					
Participate in a group discussion or blogs with other students					
Access Moodle LMS					
Viewing my student Portal					
Use Zoom/Google Meets/Skype with my Lecturers					

13. Have you ever used any of the social media listed below for academic purposes? *

Please tick all that apply

Tick all that apply.

- [ ] WhatsApp
- [ ] Facebook
- [ ] Linkedin
- [ ] Twitter
- [ ] Instagram
- [ ] TikTok
- [ ] MySpace
- [ ] Telegram
- [ ] None of the above
- [ ] Other: _____

14. Does your lecturer/s allow you to use mobile phones during the lesson? *

Mark only one oval.

- ◯ YES
- ◯ NO
- ◯ Only some Lecturers

15. Which activities did you do with your mobile phone during lecture/s *

Please tick all that apply

Tick all that apply.

- [ ] Seach for a word definition
- [ ] Record a lecture presentation
- [ ] Use a calculators
- [ ] Post a comment on a class blig or respond to a class post
- [ ] access social media
- [ ] Send email(s)
- [ ] Engage is group discussin
- [ ] Access lecture notes or studt materials
- [ ] I do not use my phone during lecture/s
- [ ] Other: _____

16. Had any of your lecturer ever used any of the applications listed below to deliver a lesson? *

Please tick all the apply

Tick all that apply.

- [ ] YouTube
- [ ] Moodle LMS
- [ ] Padlet
- [ ] Edmodo
- [ ] Skype
- [ ] Zooms
- [ ] WhatsApp
- [ ] None of the above
- [ ] Other: _____

Please state whether you Strongly Agree, Disagree, Uncertain, Agree, Strongly Agree of the following statements

17. Adoption of mobile devices in teaching and learning *

Mark only one oval per row.

	Strongly Disagree	Disagree	Uncertain	Agree	Strongly Agree
I think my lecturers must start using mobile devices during lectures					
I find mobile technologies to be fun and useful for teaching					
I always use my mobile phone to access my educational resources					
I like mobile devices as they allow me to access my academic resources any time, any where					
I think we must be trained more on how to integrate mobile devices in teaching and learning					
I will be glad if we are allowed to use our mobile phones					

during lectures					
I enjoy using mobile devices than other technological devices					
I plan to use mobile devices in my future teaching practice					

Please answer the following short questions on the use of mobile phones in teaching and learning

18. Please tell us what you consider in the most satisfying use of mobile phones in learning as a student *

19. Please tell us what you consider the most satisfying use of mobile phones in teaching as a future teacher

20. Do you think you will use mobile phones as part of your teaching in your future teaching classroom? if yes please state how? if no, please state why not? *

Fact-Finding study on mobile learning among pre-service teachers at IUM

Dear Student
Thank you for taking the time to participate in this study.

Your information will remain strictly confidential and it will not affect your study in any way.

Please indicate if you are interested to participate in phase 2 of this study.
If you are interested please click the YES column on the next page and submit the form. You will be conducted on the email that you provide for Phase 2.

If you are not interested to participate in Phase 2 of this study, please click the No column and submit the form.

For more information Contact:
Ms Alpha Ndeunyema
0811488187
email: ndeunyema@gmail.com

21. Are you interested to participate in Phase 2 of this study? *

Mark only one oval.

- YES
- NO

Appendix B: Interview questions for fact-finding study

Interview Questions (IQs): Fact-finding study on mobile learning among educators (Faculty of Education) and practitioners (IT) at IUM

Gender:
Qualification:
Years of lecturing experience:
Your age:

18-24		24-29		30-39		40-49		50 and above	

IQ1: Which teaching methods module/s do you teach the third-year secondary education students?

IQ2: Describe the teaching techniques that you are currently using to respond to the 21st-century demand of integrating technology in education/teaching.

IQ3: Did you ever allow your students to use their mobile phones during your lectures? If yes how? If not why not?

IQ4: What online resources (Journals, Open learn materials, E-library, Teaching Website etc.) did you ever use during your recent years of lecturing and how?

IQ5: Which application/s or platform/s (such as Moodle-LMS, Padlet, Google Classroom, Zoom, Skype, YouTube etc.) did you ever use to deliver your lectures?

a) How did you use the application/s or platform to deliver your lecture?
b) Which activities did you do with your students on the platform/ application?
c) Did you find the application/s (stated above) that you used helpful in teaching or not? please explain

IQ7: What is your view on how to train student-teachers to acquire knowledge of integrating educational technologies in their future classroom/teaching?

IQ8: What is your view on integrating/using mobile devices (such as smartphones, Tablets/iPads) during student-teachers training?

Appendix C: M-MLI Phase Two, Cycle One,2 and 3, Pre-evaluation Form

Mobile-mediated learning intervention Phase 2, Cycle 1, 2 & 3: Pre-Evaluation form

Thank you for agreeing to participate in this research study Cycle 1 of mobile-mediated learning intervention. This is Phase 2 of research study and you are invited to participate as you were part of Phase 1of this study in which you have completed a survey form on fact-finding study on the experiences of using mobile devices in teaching and learning among pre-service teachers at IUM in year 2020. During phase 2, data collection will be done using your mobile device to participate in an early trial of the mobile-mediated learning experience for reflection in learning, which will contribute to the identification of the issues that influenced students' use of their own devices for Mobile learning. You are chosen to participate in this survey because you are a third-year student-teacher doing Bachelor of Education Secondary Honours in 2021 at IUM and you have also participated in Phase 1 of this research study. The following conditions and interventions will be met:

1. Data collection will be in the form of daily mobile learning activities/sessions which will be posted on a dedicated Padlet "Wall" (a mobile device application, to be installed) to be created prior to each session containing a question or activity for the day. These mobile mediated learning experiences/sessions will be for the period of; two weeks for cycle 1, for about 1h30 for each session per day.

2. During the Padlet wall sessions, a group of 4 to 8 students will be formed to be involved in questioning and problem solving using your own mobile devices. During the session students may be requested to participate in pre- and post-evaluation questioning, develop artifacts, chats on the Padlet wall and completing a reflective Journal after each session.
3.Each student will be given a Pseudonyms (different name) to be used during the padlet wall sessions, the comment for each student will appear on the Padlet wall and other students will comment and discuss through dialogue as a process of mobile learning experience.
I hope to interview you as well as requesting you to complete a questionnaire at the end of each intervention cycle.
4. Your participation in this study is voluntary. You have the right to refuse to participate or withdraw from this study, at any time should you wish to do so.
5. Your name will not be revealed to anyone either verbally or in written form in the thesis or anywhere else. Pseudonyms (different names) will be used for all participants in the writing up of the research.
6. Please be advised that posting of your own pictures or pictures of others on the Padlet wall will not be allowed.
7. Be assured that refusal to participate in this study will not lead to any consequences or affect your study/marks in any way as your lecturer.
8. The data collected during the padlet wall posts /blogs /discussion/ interviews /observation/ mini questionnaires will only be used for academic purposes.

9. You are only invited to participate in the following tasks for Phase 2: Cycle 1 of this study:

(a) Complete this consent and pre- evaluation form
(b) Participate in five sessions (five days) of mobile learning tasks (using mobile devices such as laptop, Smartphone, iPad and/or Tablet) with the assistance of the researcher(the timetable will be shared)
(c) Complete a "progress report chart" after each session on google docs
(d) Complete a pre- and post-evaluation form for this cycle
(e) You are kindly required to use your own mobile devices and you must have access to internet (the researcher might provide Wifi/data access for participants)

Please feel free to contact me for further information regarding this study via email or telephone: ndeunyema@gmail.com or +264811488187.

Thank you very much.
Yours Ms Alpha Ndeunyema
0811488187 do not hesitate to contact me should you require further clarity.

*Required

Cycle 1 of Mobile Learning Intervention 2021 for secondary education students

Consent Form

Please complete the consent form below to indicate your consent for this research and once done please move on the next section to complete the pre-evaluation questionnaire form

1. Your Name? *

2. Your Gender *

Mark only one oval.

- ◯ Male
- ◯ Female

3. Year of study *

Mark only one oval.

- ◯ Third Year
- ◯ Fourth Year

4. Field of subjects specialization *

Mark only one oval.

- ◯ Commerce
- ◯ Natural Sciences
- ◯ Languages
- ◯ Social Sciences

5. Please tick all that apply *

Tick all that apply.

- [ ] I confirm that I have read and understand the information above
- [ ] I consent to participate in five sessions of mobile learning
- [ ] I consent to use my own mobile device/phone for the sessions
- [ ] I consent to complete a pre-evaluation and post evaluation questionnaire for this study
- [ ] I consent that my participation is voluntary and I can withdraw at any time
- [ ] I consent that the data collected on the Padlet posts will only be used for academic purposes
- [ ] I consent to complete a progress report chat at the end of each session
- [ ] I agree to participate in phase 2, cycle 1 of this study
- [ ] I agree to be interviewed at the end of the five sessions of this cycle

Pre Evaluation Form for the student-teachers on mobile learning experiences

Dear participant,

Thank you for agreeing to participate in Phase 2: Cycle 1 of this mobile learning experiences for students teachers. You are kindly requested to be accurate and honest as much as possible when answering the questions on this form. The anonymity and confidentiality of your participation in this survey will be highly maintained and the data will only be used for academic purposes. Please answer all the questions follows. Thank you.

6. Please state which mobile device/s do you own? *

7. List all the applications/website that you use with your mobile phone for learning purposes *

8. Did you use your mobile phones during your lectures before for learning purposes? if yes, state what activities you did with your phone, if no state why not *

_____

9. Did you use a web application called PADLET for your learning before? *

Mark only one oval.

- ◯ Yes
- ◯ No

10. If yes, on the previous question, please state what activities you did on the PADLET *

_____

_____

_____

_____

_____

11. Please rate how useful is your mobile phones is to your studies *

Mark only one oval.

	1	2	3	4	5	
Not Useful	◯	◯	◯	◯	◯	Very Useful

12. Please rate your knowledge of mobile learning (teaching learners using mobile devices) on how to integrate it in your teaching practice *

Mark only one oval.

	1	2	3	4	5	
Very Poor						Very Good

13. Will you allow your learners to use their mobile phones during the lesson in your future teaching? if yes, state how, If no, state why not *

Appendix D: Progress Report Journals (PRJs) for Mobile-Mediated Learning Intervention among participants

PHASE 2: Progress Report Journal, CYCLE ONE

Dear Students: Complete this form after the end of each session by explaining what you learnt, your experiences, what did you enjoy most, what didn't you enjoy most.

Participant Code	**Session One:** Introduction to Mobile learning authentic context (*Check understanding)*	**Session Two:** Mobile Learning authentic tasks *(Engage content learning + support communication skills development*)	**Session Three:** Apply authentic tasks to subject specialization *(Engage + check to understand)*	**Session Four**: Collaboration Tasks *(Strengthen understanding)*	**Session Five:** Reflection Tasks *(Reflect on learning + planning for future learning connections)*
St1	To be honest, I was not quite keen on getting to know this whole procedure because it seemed troublesome at the beginning with some few glitches. As we gradually navigated our way through the process, I started enjoying it. I learned more than I thought I would and at the end of the day I did not even want to get off the Padlet	Okay!! So today was a bit tricky when it came to copying and pasting the links regarding our chosen topics from the syllabus. One of our colleagues said he can help us if we struggle with that part but being me, I decided to struggle and figure it out on my own until I finally got it right! This Padlet experience is surely teaching me new tricks I tell you, to the point where I wanted to keep on uploading	First and foremost, big ups to my colleague Raimo. I was becoming a bit frustrated until I decided to seek help from him. In the end, I managed to record and upload my video. I almost surpassed the minutes because I enjoyed it so much and I almost forgot to come fill in my PRC😂 but here I am anyway! That's it from me today. Salute.	Yesterday and today have both been terrible. I feel defeated💔😭 Ever since we received task 4 I, unfortunately, ran out of data and I had to resort to using our hostel data which has been nothing but stressful thus far. Internet connection and this hostel WiFi	Task 5 was as easy as pie. Loved and enjoyed every bit of it.

	wall🦁🟫♀️👧🟫♀️🤭😄the session was extremely interesting.	images and videos but I had to stop😄 the task becomes enjoyable once you start learning how to do it correctly.		has been failing. Once again, I feel defeated, I will try again tomorrow when our lovely Miss Alpha recharges the pocket WiFi as she has been doing.	
St2	my experience during the first session was quite challenging in the beginning. The challenge that I got while trying to install the application, it happens that my device was not compatible with the app I was trying to install so it was a bit challenging and gradually i started enjoying it. It became fun, technology wise I got to know one of the useful apps that is really good for educational purposes	Honestly my experience for today was amazing, I am getting to love this application more than I was expecting. ..am asking myself why I did get to know about it earlier than this but well am still grateful that Ms Alpha introduced me to this amazing and user friendly app👏👏👏it's never late and I trust I chose a path filled with more exciting new experiences and I just can't wait to see what is in store for us 🤩🤩🤩🤩👏	Am enjoying how we are learning from each other you guys That's why the word" Teamwork "came into existence moshili [true] neeh✍️. Am enjoying this too, you guys this is just too nice than I was expecting it to be 🤩🤩👏👏👏👏 see what I thought about this👇👇👇 To be honest I was not sure when I decided to take part in this, actually after giving my	Wow, task 4 was just amazing and very much educational. Learning to develop questionnaires was really worth learning and I believe this will be useful to me in the future as a teacher. like now we are living in the era where technology is stressed in schools due to circumstances for instance COVID-	Task 5 was solely with respect to my experience, which I can briefly say that it was a journey filled with amazing experience although I had some challenges which were really not much of a concern because I believe every journey that leads to success

	(padlet) very good app indeed! To be brief it was the best experience I ever had.	Haibo maaan 😭Padlet is the plug.✒✒	name I asked that person not to send it to Mss Alpha because I changed my mind apparently I won't be available, just because I thought this was gonna be something hard😅😅😅😅😂😂 but luckily, am saying luckly because am considering myself lucky for not taking myself out😉😉😉😉the person send the name already when I asked, But eish am enjoying this now, am singing padlet in my house everytime,my housemates are wondering what is this padlet thing this creature keeps talking about😂🤧🤧🤧🤧	19, so learning how to develop questions using Google form was just amazing and it is something worth Learning??????	must have challenges. With the help of the instructions from the lecturer and from colleagues I managed and I can lastly say it was amazing stuff I experienced here on Padlet.
St3	The first session was really exciting. I gained new skills and knowledge. I was	The session was fun and wasn't that challenging. All we needed to do was work with our syllabus	Today's session shuuuuuu, a complete mind game I swear 😭 my phone is not	Today's session was very successful and exciting	Today's session was really easy, all we needed to do was answer

	exposed to so much learning comfortably on top of that I was engaging with others. At first I was lost and didn't understand anything as my things took time to load but once my connection was stable I was catching up just fine. I am really looking forward to our next session	and find our teaching resources online, copy and paste them on the padlet with my partner as we worked in pairs. The tasks keep me busy to a point of forgetting to complete the PRC form 🙈 I'm still of this opinion to say that internet connectivity still remains a challenge to me	compatible with the App that we are supposed to be used and since I'm using data it was really challenging to find my way around since it's too slow, but overall it was a good experience and as a student teacher I really learned a lot who knows I might use the skills and knowledge that I picked up in my lessons, I mean we still with Covid-19 so what better way than learning online🙇🙇👌	🙇🙇🙇🙇I finally created my first digital questionnaire and it was so much fun but as always I couldn't have done it with teamwork and corrections from here and there. I really enjoyed the session. I acquired new skills that I never knew I possessed. I keep learning something new each and Every Time and today I can proudly say that network was not a challenge to me 🙇🙇🙇🙇🙇	questions. Overall, this was really a good experience. I learnt new skills that i would one day apply not only in my academic life but also into my personal life
St4	The session was fun and more educating. Reading the experience of my colleagues was the	This session was so interesting. I enjoyed the work so much. In fact, the whole app is just the best since it's keeping us	This session was a bit challenging on my side since I have been trying to upload the video and it took a lot	Every day is a chance to gain some new experience. Today's session	Today's session was lit. It was just a reflection of what we have been doing in

	most interesting part of the whole session.	busy.	of time for it to go through. I can't finish thanking my friends who helped me out. I like the experience I am getting.	was a bit challenging since it was the first time for me to create a questionnaire. I have learned so much during the first four sessions and I believe that I won't find it hard during my research project because I was exposed to so many things that will help me during the time of my research project.	the past four sessions.
St5	The session was very productive, and the interesting part was reading comments from my colleagues	The session was very productive and educative, I enjoyed the part of posting the video itself instead of a link, and I understand I will use this in future. This was really great, as to us teachers this session taught us how to give our learners more information on certain topics. I really	Today's session was challenging, I was finding it so hard to create a YouTube video and paste it, however I managed to do it. It is a very good experience and I feel like I am the one now when it comes to the use of technology in class. Today's session	Yoooh😢😢😢😢this time I cried; this was very difficult for me. I just managed to get 4 correct questions, the last question I gave up really, I am so stressed, anyways am	Session Five was bread and better, it was very easy. I really appreciate this cycle as it taught me a lot of technological ways on how I can conduct my lesson even if I

		enjoyed this👍😘	also taught me how to follow instructions and listen very well as one of my colleagues was instructing us on how to come up with our video. Wooooow, what an enjoyable session. Dankie ms Alpha👏👏👏👏	willing to go redo again with the help of one of my colleagues.	am absent. However, it took me so long to complete the last session as I was busy with exams. It was really good and very easy👍😘
St6	The first session was a bit challenging for me. I have never used nor heard of padlet before, so I was having difficulties. But overall the experience was amazing. I now know something new about technology and I m glad to be part of this. Something I also love about padlet is that we can see and comment on each other post.	Today's session was really awesome. I had my struggle especially with posting the link that will show correctly on the padlet. Thankful to my partner who came through. I'm gaining new skills and learning new experiences. I'm grateful for this opportunity.	Today was quite challenging. As much as I enjoy the new knowledge and skills gained, I'm also struggling. I had difficulties with creating a YouTube account and handed it to my colleague who came through. I remember when I first used an XRecorder, I pressed recording but I didn't realize that everything I'm doing on the screen is being recorded 😂😂, I only came to realize it later. Overall, I'm loving this and I'm	This was my first time setting up a questionnaire and I had some challenges with the checkboxes question, I didn't set it properly as I didn't know what it should look like. But now I can proudly say that I set up good Questionnaires using different methods of setting questions	Wow😉 what an interesting time it was. I had an amazing time during all the sessions we had. Today as I reflect back, I'm proud of what I have come to know and now I have some ideas to conduct my research in the future using different platforms and also use it for teaching in the future.Thank

			getting ideas on how I will be using the padlet for my career.		you, ma'am, for the whole experience and the knowledge gained during this journey
St7	The first session was constructive and very productive, as learned that mobile learning is the future and a good way to include technology in lessons, however navigating padlet was a bit hard to navigate,as it is not the most user friendly website that one could find, and other problems such as not installing the application before time and internet problems did make the lesson longer.	Today's session was very interesting and easy because the Navel Covid 19 virus, we were kind of forced to learn how to upload assignments in pdf and word formats with different links on the University's online platform and because of that it made today's activity much easier.	Today's task was quite much more challenging as I had to record a voice overlap onto a video recording, which I found challenging and very enjoyable. I had to redo a few videos, because of noise in the back group and it left me a little bit uncomfortable, because I'm use to teaching with an audience and this time, I was all alone… but all in all it was a great experience and something I would love to try with my other colleagues.	I found today task a little bit challenging because I'm used of creating questionnaire manually and not digitally so with the help of my friends, it all worked out.	Today's task was much easier and more relaxed, as all I needed to do was answer a few reflection questions about my experience using padlet.
St8	The session was so fascinating because I learnt a skill of teaching and	Today's session was so interesting because I learnt a new skill on how to copy and paste videos	It was not easy, but wow I managed to prepare my lesson using my phone which	Today's session was something else, because I could not believe	Today's session was so interesting because I tried

	communicating using a mobile phone and I enjoyed being part of this study, especially reading my colleagues' experience comments.	And Images to the Platform. In 2019 When I was still in my first year, I used to think that maybe YouTube was only for Music purposes. In our session yesterday, I came to understand that YouTube holds A Lot Of information. As long as you have Your phone, you are good to learn new things.	makes it easier to learn using my mobile. As we are in the 4th revolution it's good to encourage our children to use technology because it makes things easier and I am so happy to be part of this fascinating group learning new things from my peers. Thank you very much, Miss alpha for giving me this opportunity to showcase my capabilities.	it…. on how I completed setting up my questionnaires. Furthermore, I came to understand that teamwork is the key to success and I learnt how to be a critical thinker. It's becoming tough but together with my colleagues, we can make it possible. On the other hand, I was experiencing network problems while preparing for my task.	my level best to complete my task on time. On the other hand, I was experiencing network problem but I managed to complete my task.

PHASE 2: Progress Report Journal, CYCLE TWO

Dear Students: Complete this form after the end of each session by explaining what you learnt, your experiences, and what did you enjoy most,
and what didn't you enjoy most.

Name (Use your Code)	**Session One:** Introduction to Mobile learning authentic context (*Enable access and mobile)*	**Session Two:** Mobile Learning authentic tasks *(To explore mobile affordance of mobile technologies)*	**Session Three:** Apply authentic tasks to subject specialization *(Multiple mobile-mediated learning activities for knowledge construction)*	**Session Four**: Collaboration Tasks *(Create mobile-mediated learning collaborative tasks)*	**Session Five:** Reflection Tasks *(Reflection on mobile mediated learning intervention)*
St2	my experience during Session One was really awesome, as it was nothing much really to be done it was just introduction on how to use Padlet 💪💪💪👌👌👌honestly it was such a nice experience	the experience of getting to know how to make use of the features on Padlet was really a good one I learned a lot			
St5					
St6	My experience using mobile learning specially padlet has been educative and useful. The first task that we did was not so	I love the fact that every time, we always learn something new on padlet. Despite being introduced to padlet	This session was a challenge for me. Firstly, due to my current location, the internet connection	This session was easy and I enjoyed it. The fun part is watching how	

	challenging as we had to record audio using a padlet and post it on the 'wall'. The only challenge I experienced during this session was changing the colour of the wall when posing. Fortunately, enough my colleague came through, and he posted a video explaining how to change the colour, which was very useful.	before, I was not aware of some features on the padlet. Session Two helped me to learn more about certain features of the padlet. This task was not so difficult.	is bad and I find it difficult to complete my tasks. I thank my colleague, who came to aid me in creating my website. This task was a challenge hence I didn't know how to place my created pictures on the website.	other people did their websites and the creative art on the website. colleagues commented on each other padlet and give ideas on how to improve the website. Most colleagues did it well without much challenge.	
St7	The experience was great and fun, as I helped the new members to navigate through the application, by posting useful videos that helped them to use padlet.	Session two was challenging, as it required us to explain features of any two features on padlet via screen recording or presentation, and that isn't something that I was comfortable doing, but I managed and I created a PowerPoint presentation	Today's session was a little bit challenging but after watching the video that Miss uploaded on her website, it helped me create my own website, step by step.	Task four was very entertaining, as it required us to provide constructive criticism on each other's websites, to everyone make their websites user-friendly for everyone.	
St8	It was so fascinating to be part of this first session, and I learnt a lot even though I was experiencing some network challenges	Session Two, was easy for me, as I was already been introduced to padlet before and I have been playing around	Session Three was so interesting and managed to complete my task on time. Therefore, I	images, links, documents, videos and voice recordings. Therefore	Padlet is an extremely easy-to-use tool that allows learners to collaborate

	but the padlet is friendly to use.	with those features. Since I was introduced to padlet, I have always been one who wants to learn more about this app. I didn't have any challenges while doing task 2.	have enjoyed taking part in this task.in addition, I learned to seek assistance from others when things are becoming challenging.	session was fun and the invaluable experience obtained shall improve our upcoming research teamwork is the key to doing more than an individual.	online by posting text, images, links, documents, videos and voice recordings. Therefore, I recommend the padlet app be utilised by the students. Finally, the invaluable experience obtained during this time will contribute to my future use such as research.
NSt1	It was fun during this session. Although, I was experiencing some constraints more specifically on how to utilize the padlet app. I felt fortunate to be working with a helpful team. I'm thrilled to be embarking on this platform as this improved my technological skillset.	Task 2 was quite a challenge. I honestly had no clue as to how to go about it. But I'm glad my team came to my rescue and I was able to do the PowerPoint presentation. I later figured out that teamwork is the fundamental key to progress. I was able to	The task was a bit challenging but I managed to create my own website. I'm still learning how to go about everything so that I fully comprehend my tasks. I'm having fun and learning a lot of things with the padlet		

	As a new padlet app user, I found this app to be very useful and educative. I learnt how to change background colours, record audio just to mention a few.	illustrate several features on the padlet and even post video on YouTube. This was one of the most awesome experiences I have encountered and I'm elated.	.		
NSt2	This is my first experience with the padlet app and I must say it's going great because I could learn how the app works by watching videos from YouTube and some recorded by my peers. I also enjoyed doing the first task on padlet such as how to comment on posts made by other people, how to change the background colour of my post, and doing an audio recording were some of the first activities I had to do and I had fun exploring them because they are easy to understand and use.	Task 2 was not that easy to do, it took me time to compete because, I wanted to make a video recording and PowerPoint presentation but my smart phone did not support the app that one can use to make a screen recording video so it resulted in me just having to upload videos for the task that we were given, which was making a video explaining the different features on padlet	These session tasks were really fun to complete. I learned how to create my own website and how to add different content and it had to include one of my specialisation subjects. It's really a nice journey of learning using technology		
NSt3					

PHASE 2: Progress Report Journal, CYCLE THREE

Dear Students: Complete this form after the end of each session by explaining what you learnt, your experiences, and what did you enjoy most,
and what didn't you enjoy most.

Participant's Code	**Session One:** Introduction to Mobile learning authentic context (*Access and mobile)*	**Session Two:** Mobile Learning authentic tasks *(To explore mobile affordance of mobile technologies)*	**Session Three:** Apply authentic tasks to subject specialization *(Multiple mobile-mediated learning activities and meta-cognitive learning)*	**Session Four**: Collaboration Tasks *(Promote abstract thinking and collaborative tasks)*	**Session Five:** Reflection Tasks *(Reflection on-action and in-action of mobile mediated learning intervention)*
St8	I learnt on how to record using a padlet app and on how to choose different colours found on it. My experience, during the utilisation of the padlet, is that everything now became easier for me since I already know how to use the padlet. I enjoyed posting my audio recording on the padlet that I posted earlier in my introduction content.	Session Two, was easy for me, as I was already familiar with the padlet features and I have been playing around with those features. Since I was introduced to the padlet, I have always been one who wants to learn more about this app. I didn't have any challenges while doing task 2.	Session Three was so interesting since we were required to create our own website. Moreover, I learned how to create my own site, which I can use in my class in the future. I enjoyed creating my website logo and decorating it to look attractive. Even Though I faced certain challenges during this task, kept me going because it was so fascinating.	Session Four was so fascinating as we were only expected to go through our colleagues' websites to see how they plan their work. I learned how to arrange my teaching resources in an orderly manner. Different people have different ways of doing things and teaching strategies. I enjoyed assessing others' tasks on whether their objectives fit the	I have really picked a lot in this cycle I think it is very vital for teachers to know how to use this specifically during this time of the pandemic, I recommend this to be turned into a compulsory module in schools. Padlet is a great tool for tracking class updates (by

	I did not enjoy the part where I waited for a longer period of time before I had excess to complete the consent form, because of the restriction that was set by the admin/developer of the Questionnaires that was requiring me to answer/complete them.			materials posted on their websites. I did not enjoy listening to all the videos posted on each website, because my data got finished.	using it in the classroom, you can track current and upcoming class assignment topics and their due dates.
NSt4	I have learned on how to create Padlet for myself and for academic purposes, and for everything, I would want to post on it. My experience with this Padlet is that I will have a platform to post my notes for my students in the near future whereby they will also be able to post their answers, be able to ask questions and be able to comment on everything I will post on it. I enjoyed listening to my colleagues' audio and	In this session, I have learned how to use some Padlet features while explaining to others and from my colleagues' videos that have been uploaded on this platform. I didn't enjoy this session because at the time for me to share the video I have recorded on the platform it first needed to be uploaded on	Session Three It was really exciting since I got a chance to create my website for the first time, I didn't have an idea how to create it before. I really enjoyed this session even at first, I was struggling to add the PowerPoint presentation slides, some pictures and videos to my web page. It really took me time to complete it but, in the end, I ended up liking the outcomes.	Task 4 It was really easy because I have just to go through all my colleagues' work for task three to go through their website and read notes and watch videos and comment on them by answering some asked questions. I enjoyed going through others' websites and checking how well they presented their teaching materials that I ended up	In this session I got a chance to share my journey in this intervention, What I have acquired in all the tasks we have done. It was really a good experience because during this holiday I learned a lot, which is a Padlet platform that I didn't know about and its use before.

	learning from them. At first, I didn't enjoy anything because everything was new to me and quite challenging.	YouTube and then I had to copy the link and paste it on the Padlet so I publish it. It was kind of a long process for me.		learning more about that. This task was more about acknowledging the good work of others and motivating them to do better in future, that is what I really enjoyed more.	Most importantly is how to create a website and adding all necessary features to be up to educational standards and attractive. With all this, I have acquired how to integrate technology in teaching and learning with a Padlet platform.
NSt5	I have learned how easy it is to use a Padlet. How to publish a video using the app, to delete, edit and choose my unique colour for my code. My experience using Padlet is that it makes teaching and learning so convenient for the teacher and learners. I had the freedom to complete the task on my own time as long it was	Slowly but surely get a better understanding of the Padlet and how works. Gained knowledge on how to do a voice-over, wonderful experience although I'm not a pro yet. Baby steps.	Task 3 was very challenging however; the instructions were of great help. Gained a vast amount of knowledge on how to create a website, how to post information on it and lastly share it on Padlet Wonderful exercise overall unfortunately my devices failed me as they kept on freezing	a beautiful experience interacting with fellow participants. Gathered more skills on how to improve my content to achieve all the objectives. Participants really gave constructive criticism. Loved everything	The overall experience was very educational. The set of instructions was really simplified and clearly indicated. What was unpleasant is that the Padlet required a phone with updated software. Some features were not supported on my

	within the given timeframe. It gives the user options on how the user would like to communicate be it in the form of an audio or video and etc. I love how Ms gave instructions on how we were supposed to conduct the task. As I was clueless on how to use the Padlet. And that I can use the Padlet without necessarily downloading the app saving me storage. What I less enjoyed was that it was not user-friendly from the get-go.	Task 2 was really exciting. I love that I'm actually learning something different every day and there was nothing I didn't like during the session.	and dialling themselves	about Task 3, especially how everyone was just so helpful and kind to each in the best possible way.	phone
NSt6	I have learned how to use a padlet since I have never used it before and this was my very first time. I have learned how to insert anonymously or with your name and it's easy to use. My experience using the padlet is that I can now				

	install a padlet app on my phone and go to the padlet website and create an account and make my board and share the link with my fellow students or learners so that we will be discussing our subjects or modules using the padlet. I enjoy listening to myself when I was busy recording my audio and also listening to my mates' audio. I did not enjoy it when I was busy trying to fill in the form because my phone was acting up and I was a bit confused.				
NSt7	I am honestly glad that Ms Alpha introduced padlet to me. she reassured me that I am going to enjoy every part of it, and am honestly already enjoying it. I love the fact that she introduced the padlet	So, we are in the second session task 2. To be honest, when I went through the instructions for task 2, I was scared that I wasn't able to	Task 3 extremely challenging but at the same time fun. Here we were asked to create a website, and going through the instructions geared some doubts in myself, it sounded extremely hard but I had	I had to go through my colleague's website, and I must say going through it, I learned a few things that could help me adjust my website…some of my colleagues'	I learned a lot on this journey and I challenged my capabilities. For every task that was given to us, we have clear instructions and we were given

	step by step, and took me through it thoroughly. I can now say with so much pride that I know how to send audio on the padlet. I could share my views with no one judging me as the app is user-friendly. And it doesn't take up too much space. And the fun part it's that we are going by code names. how cool is that?? Am honestly having so much fun. And am eager to learn more on this journey.	complete it. But as soon as I started working on it, it was so much fun as my abilities were now challenged. Today I managed to upload a file on our padlet all on my own .it was so much fun and I am looking forward to so more challenging tasks. The part I loved best about task 2 was that I am able to explain to everyone out there how to use the audio and GIF feature on our padlet.it was so much fun.	to challenge myself. when I started with it, I gained so much knowledge on how to create a website and how to go about it. I mean like I know how to create a website all on my own …I can't get enough words to thank Ms for this life-changing experience am truly grateful for being part of her team.	websites were so knowledgeable and eye-catching, that they out-did their layout as it was simply fantastic. We also had to comment on each other's work… Am honestly enjoying every part of this padlet journey. ♡□😍	adequate time to complete each task. It was really fun as we engaged pretty well with my colleagues which made everything else easier. What I enjoyed most was explaining how to use the audio recorder and GIF on the padlet. I did a whole tutorial video on these features. I also had fun creating my website…. I honestly enjoyed every part of this adventurous journey as I learned a lot from it. I would really recommend that they make use of the padlet in the academic journey.

NSt8	is My first-time hearing about Padlet. Is such an interesting app because I had to learn new things about it. Its uniqueness of using a code and having your own colour was just amazing. Actually, I was eager to know what was next for our task. I believed it will be something worth trying. The task given by Ms was very easy if you follow the instructions given. Even though I experienced a few challenges, I was able to complete the tasks and learn something new at the same time. Task one was so easy compared to task two but didn't make me give up	The fact that Ms Alpha gave us a task to do screen recording, I was like where will I even start? Based on the steps and guidance provided by her. I was able to complete the tasks and apply all the features mentioned for my use. I am looking forward to the next task to challenge my capability. The fact that Ms Alpha gave us a task to do screen recording, I was like where will I even start? Based on the steps and guidance provided by her. I was able to	Task 3 It was an amazing task. It made me realize that we got smartphones but we can use them to create certain tasks or videos. It was complicated though cause my phone can't accommodate some apps but through teamwork from my teammates, I was able to complete the tasks. Plus, all the necessary information and instructions were given to enable us to complete the tasks.	The tasks were super easy and the instructions given were peace of cake. Straight forward to the tasks. Ms clearly indicated what we need to do for the task. The fact that you have to look at other people's work was amazing. Some did an amazing job on that previous task. Four tasks are completed and are a time to get ready for the last one. The only problem I had was my phone freezing nonstop.	Session One. Based on the instructions it was very easy cause it's a reflection of what we have completed so far on the Padlet. I enjoy the recording it was very easy. Even though I encountered some technical challenges. In Session Two the tasks were very easy and the instructions given were clear given. I managed to write my list of skills gained and the whole reflection was amazing.

		complete the tasks and apply all the features mentioned for me to use. I am looking forward to the next task to challenge my capability.			
NSt9	I learnt how to use my padlet since I was not familiar with it before Since it was my first-time experience, I was failing to of do my Introduction but I had to learn how to do recordings It was all fun trying to figure out things and the later, you find it then you realise how it easy it was but I couldn't just see/find it I was finding it had on how to add information on my pallet under task 1 session	I learnt on how to use the features of the tablet e.g., the feature of link and I was able to upload it. More after completing a task I get to know more it was a bit tricky at first as I couldn't get q questions but once you understand it then no problems you will be able to do it regardless I enjoyed how I had to explore the features all alone and figure it myself how to go	More and more every day I keep on learning new skills on the padlet and it's really broadening my knowledge. There are a lot of features and you just have to be patient and learn, so, it's more like the eagerness of wanting to do something but first you have to figure out you will go about it.	It gave me an opportunity to view and see how others make their website with notes and everything It was fun to read and through the work or websites of others I got to learn a lot of things from their websites also	I learnt how to use audio or video for expressions, it was kind of tricky at first because you have to be audible in your audio and have to be always deleting which isn't really recorded audible I really enjoy doing audios it's given me the confidence to be talking as no one is watching

		about it, it's what makes this padlet discovery more and more fun I take time before I understand the task and by the time, I find out the I come to know how easy it was that's the only part I don't enjoy the most			What I didn’t enjoy is how I couldn’t change how my voice was sounding I had gotten to a point where I had to give because Ito how I am and can't change it

Appendix E: M-MLI Phase 2, Cycle One Post evaluation Form

Mobile-Mediated Learning Intervention Phase 3, Cycle 1: Post-evaluation Form

Dear Students,
Thank for being part of my journey and your participation during our mobile learning experiences. I truly appreciate your activeness, commitment and contribution towards this project. Our Final tasks is to share your experiences buy completing the post-evaluation form.

*Required

1. Your Code Name *

2. Thinking about the mobile learning experiences you just completed, please indicate to what degree you agree with each statement on the following scale *

Mark only one oval per row.

	Strongly Agree	Agree	Netral	Disagree	Strongly Disagree
The Padlet App helped me to learn	◯	◯	◯	◯	◯
I was engaged with what was going on during the mobile learning	◯	◯	◯	◯	◯
The mobile learning tasks given aided in my learning	◯	◯	◯	◯	◯
I will be able to immediately use what I learned in my future classroom	◯	◯	◯	◯	◯
The Padlet App will contribute to my future teaching	◯	◯	◯	◯	◯
I would recommend other students to apply this learning experiences in their future teaching	◯	◯	◯	◯	◯

3. How confident are you that you will apply what you learned to your future teaching? *

Mark only one oval.

	1	2	3	4	5	
Not at all Confident	◯	◯	◯	◯	◯	Extremely Confident

4. How committed are you to applying what you learned to your future teaching *

Mark only one oval.

	1	2	3	4	5	
Not at all committed	◯	◯	◯	◯	◯	Extremely committed

5. From what you have learned, which one of the following new skills/knowledge that you acquire during mobile learning (check all that apply) *

Tick all that apply.

- [ ] How to use a Padlet Application
- [ ] How to create online video lesson with voice over
- [ ] how to create a google form questionnaire
- [ ] how to use google search engine
- [ ] how to post and comment on others' posts
- [ ] how to write a Progress Report Chart
- [ ] How to use Padlet for my specialized subject/teaching
- [ ] How to teach with mobile devices

6. Thinking about the factors helped you to understand mobile learning and complete the activities, please indicate to what degree you agree with each statement on the following scale *

Mark only one oval per row.

	Strongly Agree	Agree	Neutral	Strongly Disagree
My Past Experience of using my mobile phones for learning				
Extra help that I got from the Instructor/lecturer				
Help from My collegues				
YouTube Tutorial videos about the tasks				
Chats on the WhatsApp Group				
My own efforts and discipline to apply what I learned				
Instructions given by the researcher/lecturer				
Chats and comments on the Padlet wall				

7. what suggestions do you have that would make you better able to apply what you learned in your future teaching? *

8. After your mobile learning experiences, will you use mobile devices in your future classroom teaching? if yes explain how, if no explain why not *

9. What other feedback would you like to share? *